The Welding Engineer

IONEER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

Volume XXV January, 1940 Number 1

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Welded Steel Steam-Jacketed Mixing Tank

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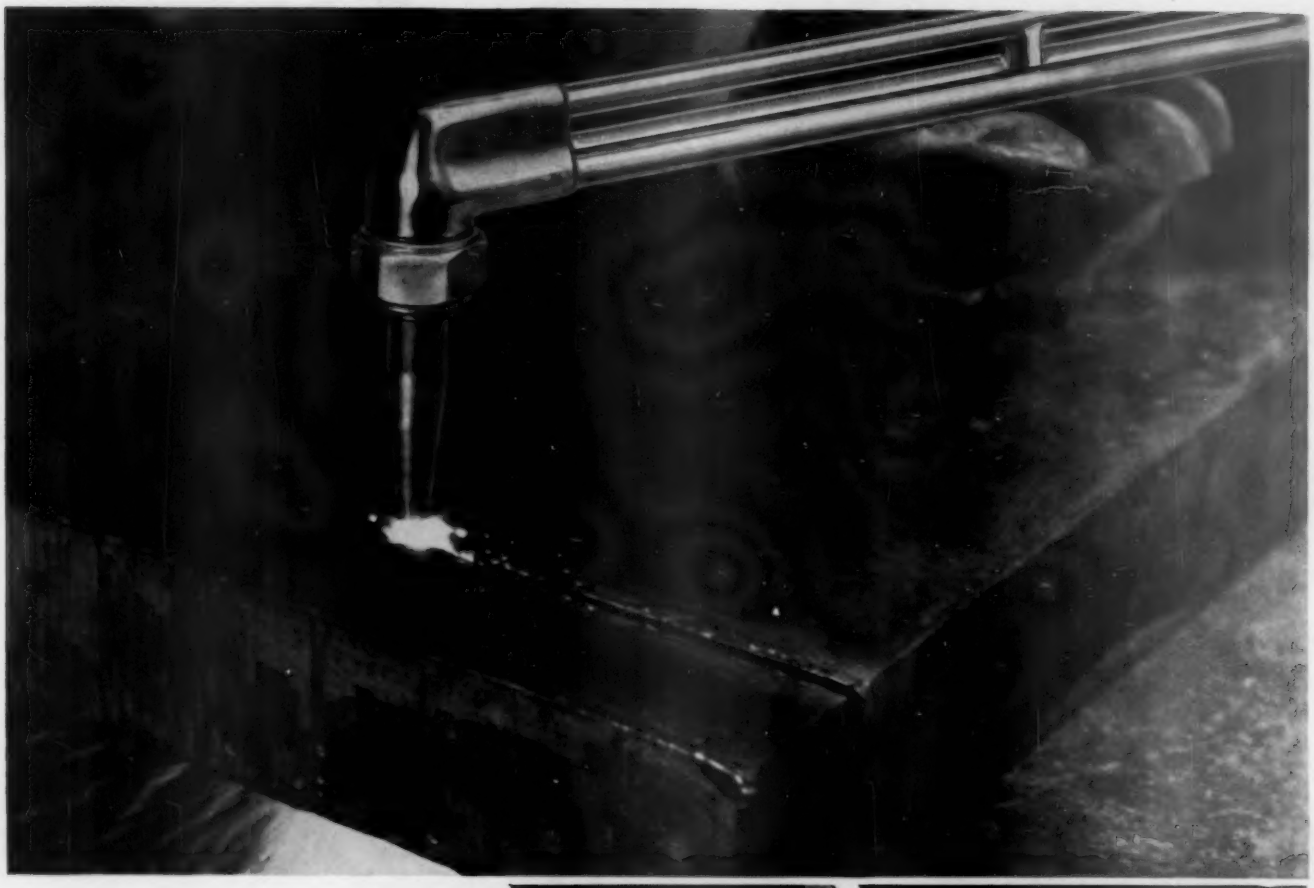

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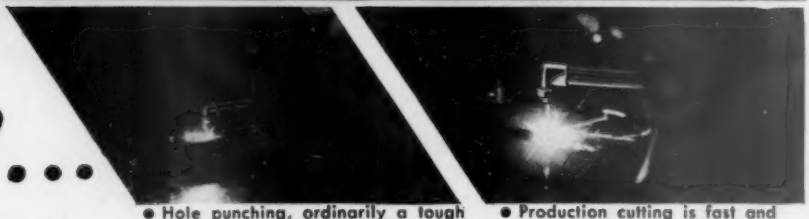

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"Welded Steel Steam-Jacketed Mixing Tank." Photo (Leader Iron Works, Inc., Decatur, Ill.).

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Technical Literature

We have listed below brief reviews of new technical literature prepared by welding equipment manufacturers. Any literature you may desire will be sent to you free of charge. Merely check or mark serial number of paragraph on order blank at bottom of page. No obligation.

Automatic Gas Flux Process

(157) **Automatic Gasflux Co.** has a 4-page folder describing the process of the same name for bronze welding and brazing. In this process the fluxing elements are carried into the oxy-acetylene flame by means of a special fluxer containing liquid flux through which the acetylene is carried before delivery to the torch.

Norton Grinding Wheels

(158) A beautifully illustrated 28-page booklet on grinding wheels has been published by the **Norton Co.** Considerable educational material is listed, including standard shapes of grinding wheel faces, wheel markings, machine tool applications, surface grinding, snagging and weld grinding by means of portable units. Mounted points and mounted wheels are also described.

M. S. A. Faceshields

(159) **Mine Safety Appliance Co.** has just issued bulletin No. CE-11 which describes the new line of M. S. A. faceshields, featuring the new "Head-line Design."

Build Your Own Welder

(160) **Lincoln Electric Co.** has just issued a 6-page folder explaining "How to Build Your Own Engine-Driven Welder." This describes a plan which will enable purchasers of Lincoln welding generators to build their own portable engine-driven welders. Those who have the necessary spare time, tools and skill, can profitably carry out the suggested plan.

Complete Arc Welding Service

(161) **General Electric Co.** has a folder GES-2306 containing helpful suggestions from three prominent G. E. welding engineers—**Roger Clark, Jack Waugh,** and **George Ross.** The subjects discussed very concisely are "Upward vs. Downward Welding on Vertical Joints," "Repair or Fabrication of Rusty or Dirty Steel," and "Straight vs. Reverse Polarity."

Steelweld Bending Presses

(162) **Cleveland Crane and Engineering Co.** has folders available featuring Steelweld bending presses, such as are used in fabricating shops to bend plates to shape prior to welding. Every bend saves a joint. The same company also has literature available on Cleveland all-welded cranes. Bridging girders, end trucks, trolley frames, and operator's cage are one-piece welded units.

200 Amp. "Shield-Arc Junior"

(163) **Lincoln Electric Co.** has an illustrated 4-page folder high-spotting the operating features of its new engine-driven 200 amp. Shield-Arc junior welder. Current range can be adjusted from 40 to 250 amps.

Soldering and Tinning

(164) "Short Cuts and Better Methods of Soldering and Tinning" is a new booklet containing information on behavior and proper use of various types of solders, as well as suggestions on short cuts on how to save labor and material. It is published by **Glaser Lead Co., Inc.**

Fume Collectors

(165) A four-page folder issued by **Ruemelin Mfg. Co.** describes the application of Ruemelin fume collectors as used in welding shops for exhaust ventilation. They are intended to eliminate undesirable fume concentrations and to increase the comfort of the welder. Smoke and fumes are collected before they can spread through the shop.

Weld Recorder

(166) The **General Electric Co.** has issued bulletin GEA-3313 describing the application of the G. E. Weld Recorder, designed to secure better spot welded structures. The device has been used in the production of aircraft and railroad equipment. By its use a record is obtained of the electrical input for every weld. Additionally, the device gives an audible signal and locks out the spot welder when the current input varies more than the limit allowed for satisfactory welding. The record is given on a continuous tape.

Electric Heat in Industry

(167) How electric heat facilitates industrial processes is described in a well-illustrated 8-page bulletin (GES-2377) issued by **General Electric Co.** A diversified group of electric heat applications are pictured showing how electric heat can cut operating cost, increase output and improve quality of production. Of particular interest to our readers are applications dealing with electric furnace brazing, scale-free hardening and heat-treating of non-ferrous alloys.

USL Arc Welder

(168) A four-page folder issued by **Owen-Dyneto Division, USL Battery Corp.,** explains the advantages of the new USL Protected Arc welder designed for use with a-c. current. Claims featured are, single control with a steady arc, wide heat selection, low power consumption and absence of moving parts. It is said that this welder can be used with any type a-c. welding electrode and will give faster, easier welding.

Hobart Transarc Welder

(169) A four-page folder issued by **Hobart Bros. Co.** describes the new Hobart Transarc a-c. welder. This unit is rated at 20 to 200 amp., for operation on 220-volt single-phase circuits. A 30-step current regulation is achieved by a simple hand-wheel control.

Wrinkle Bending of Pipe

(170) **The Linde Air Products Co.** has issued a new booklet describing the method of wrinkle bending of pipe. This process is used in cross-country pipeline installations, or where pipe must be "tailored" to fit.

Flame-Gouging

(171) This new oxy-acetylene application, used in grooving steel, is described in a new 8-page booklet issued by **Linde Air Products Co.**

Welding Accessories and Electrodes

(172) **Hobart Brothers Co.** has issued a pocket-sized booklet describing its line of electrodes, electrode holders, hand shields, protective clothing and accessories.

THE WELDING ENGINEER January, 1940

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Review of Progress

EQUIPMENT COMPANIES in the welding industry are obviously well-staffed with competent technical men to keep ahead of the needs of fabricating industries. It is very apparent from reading the reviews of technical progress, published elsewhere in this issue, that our manufacturing friends are not letting any grass grow under their feet. It is also quite apparent that technical developments come very fast in the welding field.

Those of us in the industry can certainly look to the future with confidence on account of the steady stream of new applications of welding and related processes. For example, oxy-acetylene applications are becoming much more diversified. Where formerly we had only gas welding and flame-cutting, we now have such comparatively new applications of flame-treating as: flame-hardening, flame-softening, flame-machining, flame-conditioning, descaling and flame-gouging. Flame-cutting advantages are gaining wider recognition, primarily because flame-cut parts permit the engineer to use a better functional design and permit the shop man to speed up production.

In arc welding there seems to be a trend toward a more completely rounded line of welding electrodes to meet most of the needs of the steel fabricators. Many alloy compositions are now available, with shielded arc coatings, that were not on the market a few years ago. Naturally, this broadens the usefulness of arc welding and contributes to the steady upward trend in electrode consumption. New uses for the carbon arc process are pointed out in our review articles in this issue, particularly for the fabrication of galvanized sheet metal.

A number of new equipment refinements are described in this issue, probably the most notable development being the introduction of low-current welding machines capable of maintaining a steady arc. These are finding a good acceptance for welding thin gauge materials. A polyphase rectifier type of low-current welder was introduced during the year, which is capable of delivering extremely small currents, of the order of 5 to 10 amp. Another equipment development recorded in this issue is the increased use of a-c. transformer type welders, particularly for automatic systems of welding.

Alloying Elements in Steel

WE HAVE often thought that there was entirely too much mystery regarding the function of alloying elements in steels. Probably one of the reasons we thought so, is the quite general use of S.A.E. code numbers to designate various ranges of composition. When an engineer or metallurgist makes use of an S.A.E. number, it tends to sound like some of Houdini's abracadabra. We will have to confess that this has been our feeling for sometime. The whole subject seemed hopelessly complex. We have a suspicion that other men probably have felt or still feel the same way about it.

Quite naturally we were much pleased to learn that Edgar C. Bain's series of lectures on the subject of alloying elements in steel are now available in book form. Mr. Bain's lectures were a high spot of the recent annual meeting of the American Society for Metals last October. Because of our thirst for more knowledge on this seemingly complex subject, we obtained one of these books and have just recently completed reading it. We are pleased to report that Author Bain has done a splendid job of presenting a difficult subject in such a way that a man, without much metallurgical background, can dig out a better understanding of the functions performed by alloying elements.

Anyone who reads this book will gain a better understanding of hardenability, which is a concept rather difficult to define, and he will also obtain the distinction between hardenability and intrinsic hardness. The welding man who reads the book will appreciate why there may be greater difficulties in welding certain of the alloy steels, because of their greater hardenability as compared to carbon steels. The presence of alloys slows up the austenite-to-ferrite transformation, so that steels can be hardened at considerably slower cooling rates than is possible with carbon steels. With an increase in hardness there is an invariable loss of ductility, and it is this physical property which is very important.

Author Bain points out the remarkable similarity in physical properties of a group of alloy steels, when each is tempered to approximately the same Brinell hardness value. The thought is also advanced that when these steels are put through such heat-treating cycles as to result in substantially the same hardness, same austenite grain size and same degree of homogeneity of composition, there would be even less of a spread in physical properties. A better understanding of this important fact should give the welding man more confidence.

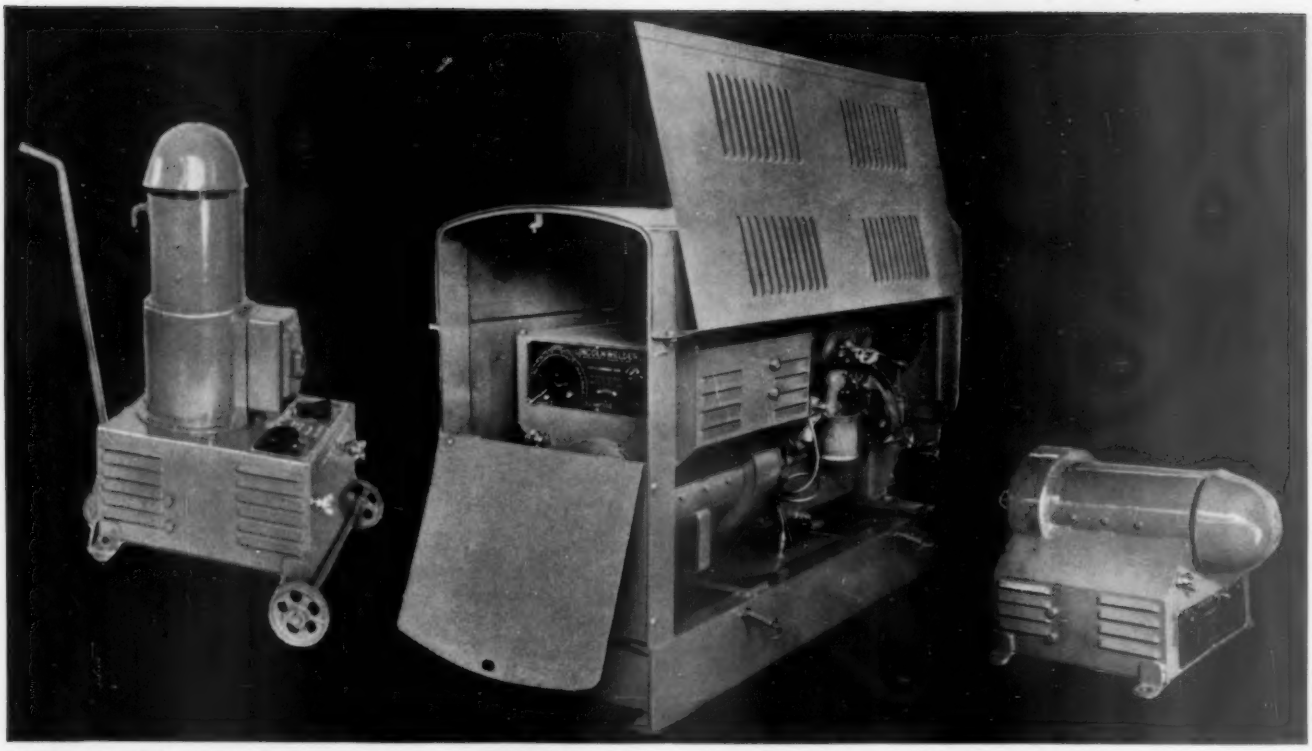

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Fig. 1—Removal of these welded studs, one of many applications of flame-gouging, is accomplished in less than one-third the time formerly required. Photo (Linde Air Products Co.).

Review of major

1939 developments in the

Oxy-Acetylene Process

★ Applications of flame-treating include flame-hardening, flame-softening, flame-machining, flame-conditioning (deseaming), descaling, and flame-gouging

IT WAS NOT SO LONG AGO that oxy-acetylene developments could be readily classified under two general headings, "welding" and "cutting." Welding was first of all a repair method, while cutting was used for the rough shaping of parts or demolition of structures. From this the process was developed into a precision method employing all the refinements of engineering skill. While welding and cutting remain indispensable methods for doing the jobs for which they were first developed, recent years have seen their introduction in many new fields, such as flame-treating, and their development as major production processes. Applications of the flame-treating process include such operations as flame-hardening, flame-softening, flame-machining, flame-conditioning (deseaming), descaling, and gouging. In addition even a brief review of progress in the welding industry must make mention of the advances made in mechanized, high-speed welding, which are proving of great industrial importance.

New Flame-Treating Operations

Of the flame-treating operations, descaling and gouging are the most recent, having been announced within the past few months, and it is safe to say that before many more months they will prove just as invaluable to the metal worker as the other new techniques.

Flame-descaling provides an efficient means for removing the scale from blooms, billets, slabs, forgings and steel castings by means of specially designed oxy-acetylene heating heads. The process is based on the principle that when quick, high-temperature heating is applied to the scale (or oxidē skin) on a piece of cold metal, the scale expands and breaks away from the base metal, because of a differential expansion between the scale and the steel. While descaling has a number of advantages over other cleaning methods, such as pickling, sandblasting, and chipping, one of the most important is the speed of the operation. For example, steel foundries find that castings can be descaled in as little as one-fifth the time required by chipping.

Gouging, the second of the most recent oxy-acetylene developments, is to metal working what the carpenter's chisel is to woodworking. In spite of the short time that the process has been tried in the field, it has already proved an inexpensive means for performing in a matter of minutes a wide variety of operations formerly requiring many hours of tedious chipping, grinding, and planing. Originally, gouging was developed for removing metal from the underside of welds, for removing weld defects revealed by visual or X-ray inspection, and for removing temporary tack-welds. The immediate success of the gouging blowpipe for this type of work soon led to its use for a variety of main-

Fig. 2—A special multi-flame head speeds mechanized welding of tubing for reservoir tubes of shock absorber. Tubing is welded at rate of 12 ft. per min., immediately after passing through forming rolls. Photo (Linde Air Products Co.).

tenance operations, and, more recently, for the preparation of plate edges for welding. The principle of the process is based on the fact that if a nozzle, designed to deliver a relatively large jet of oxygen at low velocity is properly manipulated, a smooth, accurately defined groove can be cut or gouged out of the surface of the metal. This is essentially what is done in conditioning steel when defects are removed by the oxy-acetylene deseaming blowpipe.

Mechanical Welding

Keeping in step with other spectacular developments, the oxy-acetylene process has been further consolidating its position as a rapid and economical means for joining metals. Here, the trend has been along lines more effective utilization of heat. This has resulted in the use of multi-flame tips and the mechanization of the motion of the blowpipe (torch) with respect to the work, particularly in the case of repetitive production operations.

While it is generally conceded that the current trend of development in high-speed welding is towards mechanization, it may be said that, until recently, the inherent flexibility of the oxy-acetylene flame paradoxically handicapped mechanization of the oxy-acetylene process. In other words, because of this flexibility the oxy-acetylene flame has been used almost exclusively in hand-operated welding blowpipes, where flexibility was a predominant requirement. Now, however, it is becoming more and more evident that mechanization with the oxy-acetylene process offers very definite possibilities, particularly for a large number of sheet metal applications.

Of considerable interest, and perhaps as one of the most spectacular examples in the field of mechanization, is the recent development in tube welding. For this operation, increases of as much as 300% in the speed of welding have been accomplished in the last few years. For example, with 20-gauge material it is now possible to weld continuous tubing at a rate of 50 ft. per min., whereas a few years ago a speed of 15 ft. per min. was considered much better than average.

Latest developments also seem to indicate a definite trend towards mechanization by the oxy-acetylene process in that field of mechanical welding wherein welding rod or added weld metal is required. This is equally true with respect to both ferrous and non-ferrous metals. Among such developments, now either in commercial use or nearing commercial introduction, is the welding of steel containers which are made up of halves joined with a single circumferential weld. The mechanical welding of aluminum beer barrels of a similar design also appears to be very near to commercial utilization.

Mechanical Bronze-Welding

Present indications also seem to reveal a very broad field for application of mechanical bronze-welding, using the oxy-acetylene flame in conjunction with vapor-flux. This principle is applicable not only to steel, but also to non-ferrous metals such as Everdur and copper, and to copper- and Everdur-clad materials. Bronze-welding speeds ranging from 6 ft. per min. on 20-gauge material to 3 ft. per min. on 11-gauge material have been obtained. Material as thin as 28 gauge has been joined successfully by oxy-acetylene mechanical welding at speeds of better than 10 ft. per min.

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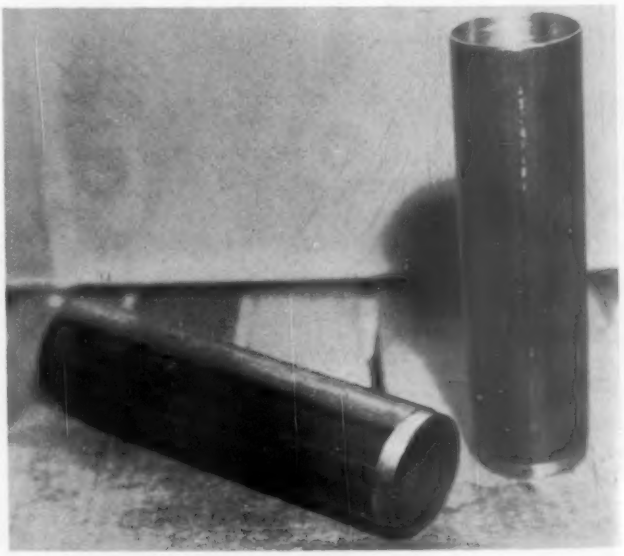

Fig. 3—The completed tube welds are uniform and strong. Photo (Linde Air Products Co.).

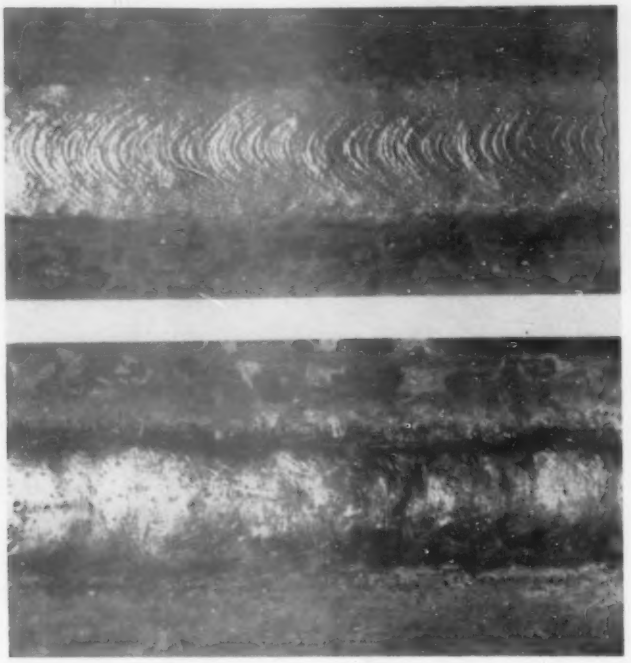

Fig. 1 — Smooth finishing weld as made possible by a 1939 electrode development. Lowers grinding and finishing costs. Photo (Lincoln Electric Co.).

Review of developments in

1939 Arc Welding Progress

★ Improved equipment and electrodes will broaden application of welding and also facilitate use of the process—New fields opened for the carbon arc

By C. M. TAYLOR
Vice-President, The Lincoln Electric Co., Cleveland, Ohio

MANY IMPORTANT new developments, which contributed to progress of the welding industry, were brought out during 1939. These new developments will contribute to welding progress in two significant ways. Some of these developments will (a) broaden the application of welding, while others will (b) facilitate and simplify use of the process. Both types of developments will be reflected in important benefits to industry in general, since they will make the advantages inherent in welding still greater.

In the first group (a) of 1939 welding developments were: (1) a new electrode which makes it possible to arc weld stainless steel of 18-8 analysis, commonly known as 18-8 S.M.O., thus making available in all applications for this metal the cost savings and other advantages of welding; (2) a new electrode which permits building up of steel parts and surfaces to resist deformation and wear, which will greatly reduce maintenance costs on equipment of many types; (3) a new electrode which makes it possible to salvage worn manganese steel parts of the 11-14% manganese type; (4) a new electrode for arc welding alloys of 70-80% nickel, 11-15% chrome and 6% iron, thus making available the many benefits of welding in all applications for this alloy; (5) a new surfacing material in the form of a fine alloyed powder for applying a smooth dense hard surface by the carbon arc process; (6) a new 200-amp. arc welding set for use with belt or direct drive in garages, blacksmith shops, commercial welding shops and industrial plants; (7) a new 150-amp. arc welder for belt drive where power such as an automobile engine, line shafting or an electric motor is available.

In the second group (b) of 1939 welding developments were: (1) a new electrode which makes it possible to reduce grinding and finishing costs of welded products by providing smooth finishing beads; (2) a new welding rod which improves arc characteristics and arc striking when welding with small a-c. transformer type arc welders; (3) a procedure, utilizing

Fig. 2 — Collection of galvanized steel parts fabricated by means of carbon arc welding. Photo (Lincoln Electric Co.).

the carbon arc process, which improves welding of galvanized steel by greatly reducing disturbance in the galvanizing; (4) a simplified method, also involving the carbon arc, of repairing cracked and broken automobile fenders and bodies; (5) application of engine starting to diesel-driven welders, thus assuring quick starts in any weather with the type of drive which is notable for its economy; (6) a new 200-amp. gasoline engine driven welder which greatly facilitates and simplifies engine-driven welding by virtue of its light weight, small size and low cost; (7) further refinements and improvements in a system of arc control, which make it possible to improve quality of welding and reduce its cost by permitting use of exactly the right type and size of arc in all applications of welding.

The new 18-8 welding rod makes the advantages of arc welding available in the manufacture, fabrication and construction utilizing any one of approximately 23 different alloys, commonly known as 18-8 S.M.O. Products and structures utilizing these steels can now be produced with the simplicity and low cost of arc welded construction.

Deposits to resist deformation and wear, which are provided by the second electrode in group (a), have a hardness of approximately 20-35 Rockwell C when applied on straight carbon steel and allowed to cool naturally. The deposit is machineable at slow speed and the exact hardness will depend upon the rate of cooling and the analysis of the steel. Typical applications of this metal include: shafts, axles, collars, flanges, locomotive and tractor parts, agricultural implements, vise jaws and other similar equipment.

Weld metal provided by the electrode for building up 11-14% manganese steel has a hardness of 5-10 Rockwell C as deposited and will rapidly cold work to a hardness of 46-52 Rockwell C. The structure of the deposit and its wear-resisting qualities are equal to those of heat-treated cast manganese steel. This new electrode possesses alloys which make the weld air toughening.

High-Nickel Electrode

Metal supplied by the electrode for welding 70-80% nickel, 11-15% chrome and 6% iron is non-tarnishing. Originally introduced into the dairy industry, this electrode is being used to great advantage in a number of different applications in the food industries including storage tanks, coolers and vats; in the canning industry for kettles, cookers, etc. and in airplane manufacture for exhaust manifolds, in textile machinery, distilling and brewing equipment. The electrode is effective in all applications where a high interior finish, as well as corrosion-resisting properties, are necessary.

The fine grained alloyed powder, which provides smooth dense hard surfaces to resist abrasion, can be applied with the carbon arc in very thin layers if desired. When properly applied, this material will provide a coating with a hardness of approximately 54 Rockwell C. The metal develops its full hardness as deposited and maintains its hardness and resists scaling at high temperatures. Corrosion resistance compares favorably with stainless steel.

The new 200-amp. belted or direct driven welder was developed to meet demands of garages, blacksmith shops and other installations where the welder may be direct coupled to an automobile engine or belted to a power take-off from an engine, or connected by belt to line shafting or electric motor. This unit has a wide range of application, which includes light gauge metal welding, repair of cast-iron parts, fabrication work of many kinds, hard-surfacing and practically all of the many profitable applications for d-c. arc welding. It can be used for welding practically all metals and alloys with either bare or shielded arc type electrodes.

Smooth Finishing Bead

Developed to minimize first costs in equipping for arc welding, the new 150-amp. welder can be used in conjunction with an engine or electric motor drive. Like the 200-amp. unit, it can be belted to an automobile engine or a power take-off or connected to line shafting or an electric motor. Both the 150-amp. and 200-amp. welders are equipped with Class B (non-inflammable) insulation and can be operated with relatively large size electrodes at high amperage without danger of burn-out. This allows faster sustained welding at lower cost.

In group (b) of the 1939 welding developments, the electrode which reduces grinding and finishing costs of welded products, provides full slag coverage and a smooth bead when making downhand welds on flat surfaces. It can be used with a-c. current or either normal or reverse polarity on d-c. Because of the smooth welds provided by this electrode, the work of grinding and finishing welds is greatly

Fig. 3 — Repairing a cracked automobile fender by use of carbon arc welding. Photo (Lincoln Electric Co.).

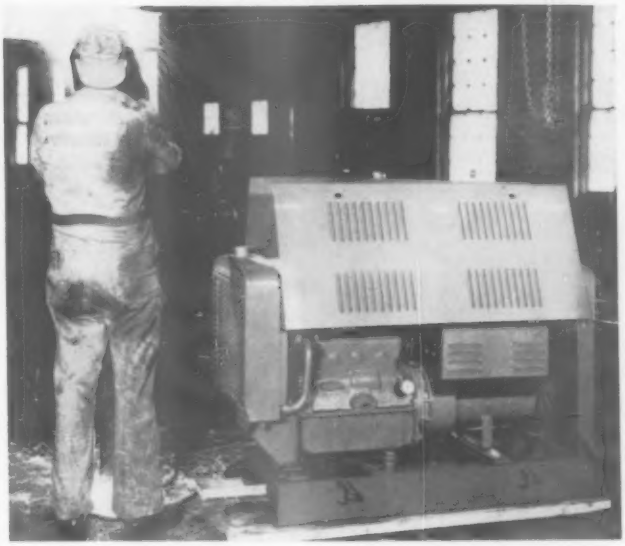

Fig. 4 — Using a new 200-amp. engine-driven arc welder by small size, light weight and low cost. Photo (Lincoln Electric Co.).

reduced and in many applications entirely eliminated.

Troubles, such as poor arc stability and difficult re-striking of the arc, sometimes experienced when welding with small low-voltage transformer type welders are virtually eliminated by the new electrode developed for use with this type of welding equipment. It is a low carbon steel electrode with a heavy extruded shielded arc coating. It is intended for general welding and repair work on light gauge sheet steel. It operates well with direct current negative polarity. The weld metal possesses high strength and ductility.

Sheet Metal Welding

Use of the carbon arc process for welding galvanized sheet steel opens up an entirely new field of profit possibilities for sheet metal shops. This process provides advantages which cannot be obtained by conventional procedures, because of the very slight disturbance to the galvanizing and the high quality of the weld. Also important is the great simplicity of this method when compared with less modern procedures. Use of the carbon arc method is increasing rapidly in fabrication and erection of pipes, duct work, stacks, sky-lights and all other products and structures made of galvanized steel.

Carbon arc welding used in conjunction with a d-c. welder of motor-generator type has further advantageous application in garages and automotive repair shops for repairing cracked and broken fenders and bodies. The advantage in this method lies in its great simplicity. It requires less preparation of work, permits speedy deposit of metal, provides excellent bond with quick concentrated heat, reduces finishing operations by the easy machineability of the weld metal and greatly lessens cost of such work. Use of the carbon arc method requires no special skill. Any workman who has ever done any brazing and welding can do a first class job after moderate practice.

A decisive advance in diesel design for use in driving arc welders is a new diesel power plant equipped with gasoline engine-starting and comparing favorably with conventional gasoline engines in size, weight, operating speed and cost. The addition of engine-starting assures quick easy starts in any weather. Reports show that this diesel engine welder cuts fuel costs 33% to 86%. In many cases, total savings run as high as 40 cents per hour.

The new light weight 200-amp. gasoline engine-driven arc welder affords a new experience in moving and handling engine-driven welding equipment. It is light enough (only 900 lbs.), to be wheeled readily by one man. Ease of moving and handling the unit is further enhanced by its small size. It is only 56 in. long, 20¼ in. wide and 37¼ in. high. The price of this unit is so low that it places arc welding within range of garages, automotive repair shops, job welders, sheet metal contractors, light metal fabricators and other concerns who can utilize welding to advantage.

Independent adjustment of both current and voltage on the modern arc welder eliminates "compromise" settings, which result in sacrifice of welding speed or welding quality. Current and voltage may be accurately adjusted to obtain the welding arc which is exactly right in both type and intensity for every welding application. Adjustments can be made in continuous steps, as fine or as large as desired.

A Steady Advance

These new developments, all produced, during the relatively short period of twelve months, bespeak the steady progress, which is being made in the welding industry. Each year sees welding advance. As long as new applications for the process are brought to light, either by users or by manufacturers of welding equipment, the industry should continue to have a bright future. This future is assured by the comparatively limited extent to which welding is being employed today. Statistics show that the process is being employed in only approximately 20% of its possible applications.

New "Clear-View" tractor is arc welded. "Rush" Hamilton of Oakland, Calif., is the builder of this unique looking tractor. He expects to get into quantity production on this model for both agricultural and industrial markets. Will be available in sizes ranging from ½ ton to 10 tons. Photo (F. Hal Higgins).

Electric Welding During 1939

By R. F. WYER*

★ The upswing in the shipbuilding industry during the past year brought about a corresponding demand for heavy welding equipment, particularly of the multiple-operator type. By their very nature, multiple-operator sets are ideally suited to use in shipyards, because in this service the individual operator's duty factor is low; the load is concentrated; and space for portable welding equipment is at a premium.

In other fields, an expanded use of a-c. welding was particularly noticeable. Generally speaking, the transformer-type welder proved to be the most popular a-c. equipment, probably because of its higher efficiency, lower no-load loss, and absence of maintenance expense as compared with rotating-type apparatus.

Automatic Welding

An increase in application of automatic electric arc-welding heads during 1939 was noteworthy. Improvements in electrodes for this use and the general business improvement played an important part in the wider demand for such equipment.

By and large, electrodes were improved with regard to quality, uniformity, and variety of types available.

In the sphere of d-c. welding, new equipments featured improved welding characteristics especially in the lower amperage ranges. There was a marked trend toward simplified construction and compact control particularly in the smaller ratings where high-speed sets are making their appearance.

Among the developments in resistance welding equipment was a weld recorder, an instrument that, if faulty voltage or current threatens to spoil welds, sounds a warning, locks out the equipment, and records the variations of electric input. Several important spot-welder control devices were also developed, and the introduction of series capacitors for power-factor correction of resistance welding machines offered many advantages. A "pointer-stop" ammeter and a "pointer-stop" voltmeter were also announced.

Multiple-Operator Equipment

A redesigned 1,500-amp. constant-potential arc-welding set offers more compact construction, improved appearance, and lighter weight. In addition, greater convenience for the operator has been brought about by mounting the control for the motor and generator on the base.

Constant-potential motor-generator sets are ideally suited for supplying the heavy current demands of modern automatic welding and the exacting requirements of production hand welding by a number of operators.

These redesigned multiple-operator equipments are ordinarily equipped with standard d-c. or polyphase a-c. motors, but where power-factor improvement is desirable they can be supplied with synchronous motors.

Single-Operator Arc Welders

Newly introduced was a 300-amp. arc welder driven by a 4-cylinder diesel engine, with starting engine and clutch. The unit is particularly of interest where a welder is used 2000 hrs. or more per year, since a diesel engine saves in the neighborhood of 75 per cent of the cost of fuel; it requires half the volume of fuel, and the fuel cost per gallon is also in the neighborhood of half. To justify the added investment with a diesel, however, the welder must be used a good part of the time.

A 200-amp. arc welder driven by a 4-cylinder gasoline engine was added. It has no self-starter, and has a lower price. In this connection it is interesting to note that some contractors insist on a hand-cranked machine, because of their experience with batteries being stolen or replaced with old batteries by unauthorized persons. The new welder is unusually quiet since it is cushioned in rubber, and mounted on a fabricated steel base. It fits crosswise in a truck body and is provided with a lifting eye for easy handling. The weight is 1220 lb.

To extend the range of the 150-amp. arc-welding transformer announced the previous year, 100- and 200-amp. ratings were developed. Small size and weight, and easy operating stepless control for fine adjustment of current are featured.

Electrodes

Conspicuous in a new line of electrodes for both manual and automatic operation is one especially suitable for high-speed, single-pass, horizontal-fillet welding where good appearance is a required factor. While primarily intended for a-c. welding, this electrode can also be used with d-c. equipment. Two new plants for the manufacture of electrodes were erected during the year, one at Baltimore, Md., and the other at Cleveland, Ohio.

Prevents Corrosion

Special liquid preparations were developed to meet the need of fabricators for materials which, when applied to metal to be lap welded, would prevent corrosion at the point where the plates overlap. They will prevent adhesion of weld spatter when applied to parts before welding. On lap welds they will prevent corrosion at the overlap. They will also protect unwelded plates in storage and will serve as a base for painting.

Resistance Brazing

For incandescent carbon resistance brazing there was brought out a new outfit comprising a low-voltage transformer, control foot switch, brazing tongs, and interconnecting cables. The newly designed brazing tongs have a fixed hinge and only one adjusting screw, and are of such small size that they are applicable to work in restricted space. The jaws, of nickel-chromium alloy steel, have high strength at elevated temperatures. The copper straps conducting current into the jaws and thence to the carbon blocks are silver-brazed to the jaws.

Weld Recorder

Particularly advantageous for spot welding on aircraft, railway equipment, and other structures where faulty welding would be disastrous, is a weld recorder, which is a recording instrument, warning device, and lock-out control. When a variation of the electrical input is outside of pre-set allowable limits for successful spot welding, a bell gives a continuous audible signal, and the weld-initiating circuit is opened automatically, and sub-

*Industrial Dept., General Electric Co., Schenectady, N. Y.

sequent welding is prevented until a push button is pressed. Simultaneously, it records on a paper chart the variations of electrical input to the primary for each weld, compared with the predetermined normal, and indicates visually the per cent variation. The weld recorder includes an "ampere-squared-second" recording instrument, a current transformer with taps on the secondary to provide a wide range of adjustment, and other associated relays and potentiometers.

Pointer-Stop Ammeter

For such as welding currents, lasting only a fraction of a second, a pointer-stop ammeter was developed, consisting of a conventional instrument with an adjustable stop for the pointer added. By adjusting the stop to push the pointer up-scale until a point is reached where a current pulse barely moves the pointer, currents lasting only 3 cycles (1/20 sec.) or more can be measured. The new ammeters were made available for use with either permanently installed current transformers or split-core transformers, thus permitting measurements without cutting conductors. Such instruments provide welder-current measurements allowing work to be successfully transferred from development shop to production machines, or from one machine to another. Pointer-stop voltmeters for measuring voltage dip were also produced.

Weld Sequence Timers

For air-operated spot welders there was produced a line of sequence timers, in which a direct-reading calibrated dial permits adjustment of time for each of the timing intervals. The timers are suitable for operation on 110, 220, 440 or 550 volts, 50 or 60 cycles. In operation, the solenoil valve of the timer is energized to create full pressure of the electrodes on the work. After a time delay, called the "squeeze" period, power is applied for a predetermined "weld" period, and then during a "hold" period, the metal is allowed to "freeze" before the electrodes are lifted. There is then an "off" period before the panel repeats. Timers to provide for interrupted spot welding (repeated applications of current to the weld) were also introduced.

Electronic Control

A combination electronic control for resistance welders was made precisely synchronous in operation and suitable for mounting all available sizes of water-cooled ignitron tubes. It is a complete electronic timing circuit, suitable for spot, interrupted spot, and seam welding. Independently calibrated dials permit selection of precise timing required for each current flow and each "off" interval, and there is a dial to permit selection of the total number of current impulses for interrupted spot welding.

Ignitron Contactor

A wider range of current is covered in a new line of ignitron contactors, introduced the previous year. Such contactors were made available for currents of 270, 450, 1,250, and 3,500 r.m.s. amp., when operating on a 20% duty cycle, using two of the ignitron tubes. An auxiliary panel with the contactor provides heat control, or current adjustment by the phase-shifting method. By means of a dial the operators can select such portion of each half-cycle as required to deliver the effective r.m.s. current* for good welding. The phase-shifting method of heat control provides a smooth adjustment from maximum down to approximately 20% on 440 volts or 40% on 220 volts.

*Root-mean-square current. This is the a-c. value which produces the same heating effect per ampere as in d-c. circuits.

Power-Factor Correction

Series capacitors were introduced for power-factor correction of resistance welding machines. Among advantages resulting from their use are reductions in kva. demand, line regulation, interference between welders, light flicker, disturbance on feeders, and power cost by lowering peak demands. They also permit use of larger or of more welders on existing feeders. The capacitors may be mounted indoors or outdoors, on the ceiling, on a pillar, or anywhere convenient. Units may be built up to any rating to fit requirements.

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1939 Arc Welding Progress

By W. W. REDDIE*

★ Progress in arc welding during the year has been outstanding, notably in the fields of railroad car building, shipbuilding and heavy machinery construction. This has not been due so much to new developments in welding machinery, electrodes, and technique as to expansion in industries named. It is a tribute to welding manufacturers collectively that their products were developed to the point where they were ready for the immediate service of industry at a time when it was essential to increase production from a low level to peak proportions, literally, almost over night.

The increase in the use of alternating current as a source of welding power, using transformer-type welders, has been outstanding during the year. This has taken two directions, first the use of unusually large amounts of power for automatic systems of welding and secondly the use of unusually low welding currents.

Alternating-current transformer type welders have been found to supply the need for high current, heavy duty welding most efficiently and economically and the development is toward 1,000-amp. units. These may be operated singly or in parallel; for example, some of the largest installations use four 1,000-amp. welders, with various combinations of single and parallel operation to provide current ranges from 200 to 4,800 amp. The use of these automatic systems has tremendously speeded up welding operations in shipbuilding and carbuilding.

In the field of medium and light manual welding operations, improvements in a-c. electrodes has stimulated the use of alternating current. Electrodes have been improved to the point where a-c. welders are readily used with current values down to 20 amp. with low open-circuit voltages. The development of small a-c. welders, with a wide variety of types of electrodes has brought the use of arc welding within the range of many small welding operations where it was previously unjustifiable on account of limited requirements. Economy, of course, requires that all types of a-c. electrodes perform with equal success

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when used with direct-current arcs.

The use of diesel engine-driven welding generators in the construction field, for locations where electric power is not available, increased during the year. Equal reliability with gas engine drive and lower operating costs will justify the continuous use of more diesel-powered units.

Transformer type a-c.-welders are being used successfully on construction work in locations where electric power is available. Earlier questions as to the adaptability for overhead and vertical work in outdoor construction have been settled by actual use of the machines.

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New Uses Reported for Non-Ferrous Alloy Facings

★ Haynes Stellite Co. reports new uses for cobalt-base and nickel-base alloys in 1939 and claim that developments indicate a definite trend toward standardization by machine tool manufacturers. Wear strips for boring bars and other machine shop equipment are now made of the same alloy composition as the cutting tools. These alloys have also invaded new fields through increased use of hard-facing as a means of prolonging life of wearing parts of machinery. Corrosion-resistant nickel-base alloys are being used for making larger and larger equipment, and technological developments leading to easier fabrications have been in evidence.

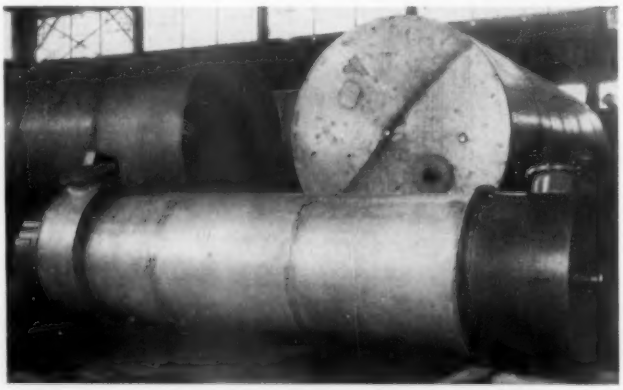
Standard wear strips, consisting of steel bars to which is brazed wear-resistant, cobalt-chromium-tungsten alloy, now assure constant accuracy and long life for boring, driving, and pilot bars used in metal-cutting operations. These wear strips are also useful as wearing plates for jigs and fixtures, for indexing stops or locks, and for permanent gauging surfaces, sliding T-slot surfaces and other surfaces requiring high resistance to abrasive wear.

In a large railroad classification yard, this alloy is applied by the oxy-acetylene welding process to more than 600 parts in a single car-retarder unit, and 24 such units have been hard-faced there. Car retarders, protected from wear by such hard-surfacing, have given exceptionally good service for 5 yrs., having withstood, without noticeable wear, the impact and abrasion of more than 16,000,000 wheels in motion.

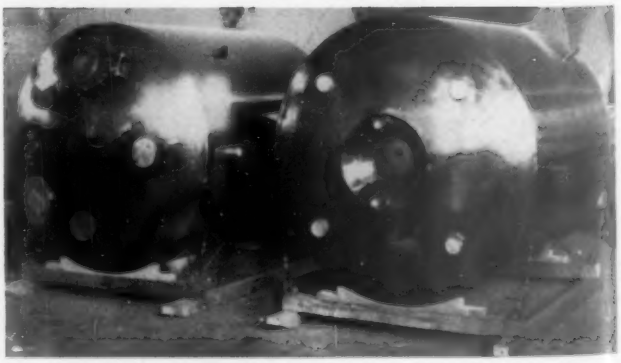
The problem of obtaining long-lived steam turbine blades has been solved by the use of cobalt-chromium-tungsten alloy. When it is considered that the tip ends of turbine blades move at speeds as high as 750 m.p.h. and must withstand the impact of water particles condensing in the steam, it is obvious that much damage can result. One solution has been to use shielding strips on the blades. These strips are made of a composition of cobalt, chromium, and tungsten which can be rolled and then formed to the proper shape. The strips are applied to the turbine blades by silver soldering. After many comprehensive tests, these alloy strips have been adopted by two of the largest turbine manufacturers, and their performance has fully confirmed the initial tests and assured the use of alloy strips for the purpose.

The extent to which hard-faced valves for high-pressure, high-temperature steam have been adopted by power plants and other users of steam is perhaps best illustrated by a recently published statement from one valve manufacturer to the effect that in an 8-month period this company has produced a total of 52,624 valves with seating surfaces hard-faced with this non-ferrous alloy.

A welded, lead-lined head for a refinery vessel. Photo (Leader Iron Works, Inc.).



A welded copper condenser. Photo (Leader Iron Works, Inc.).



Welded stainless steel kettles, jacketed and cork insulated. Photo (Leader Iron Works, Inc.).

An oxy-acetylene torch is used in silver brazing of a pipe fitting. This is a widely used heating method in brazing. (Fig. 4 in the author's series of captions.)

Recent advances in low-temperature

Silver-Alloy Brazing

★ Joint design is important—Advantages of pre-placed alloys—Analysis of commonly used heating methods—New applications

By H. A. FOLGNER
Sales Engineer, Handy & Harman, New York City

WHILE THERE HAVE been no outstanding silver brazing alloys introduced during the past year, many new uses have been developed for alloys of this type and considerable progress has been made in their application and in the various methods of obtaining the heat needed to flow them.

Remarkable strides have been made with alloys of this type in their application to non-ferrous, ferrous and dissimilar metals. This has been especially the case on production operations and the reasons for this expanding use are traceable mostly to a close and thorough study of individual brazing problems.

With a given job to do, the first question to settle is the type of joint that suits conditions best. Considerable information has been printed on joint designs best suited to silver brazing and details are available about the different kinds of joints, a few of which are shown in Fig. 1. In this connection, a point to keep in mind is that silver brazing alloys should not be used as fillers or on V type joints. They flow very rapidly into narrow openings and the strongest joints are always obtained by using small clearances.

A rapidly growing development is the use of preplaced alloys. This practice is increasing because of the ease with which silver alloys can be produced in all sizes of wire and thicknesses of sheet.

Where flat stock or tubular members are to be joined, these brazing alloys are being preplaced in the following forms:

1. Inserts of thin sheet stock and flat washers.
2. Rings of round wire or other shapes.
3. Alloys sprayed on surfaces.
4. Filed or powdered alloys.
5. Surfaces "tinned" by dipping or other methods.

The forms most widely used are sheet, washers and wire rings. When alloys are preplaced between flat surfaces, a little pressure helps in obtaining the best bond. Figure 2 shows a typical ring application.

In making tubular joints the reservoir method of preplacing brazing alloys is now being used a good deal. Outside reservoirs, when used, are placed so that the flow of the alloy

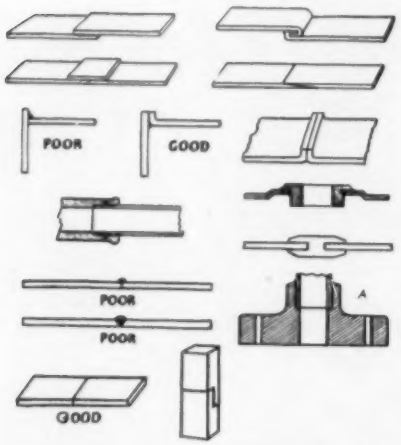


Fig. 1—A few joint designs for brazing, including "how not to do it." The strongest joints are those with small clearances.

will be vertically downward, as shown at *a* in Fig. 3. When inside reservoirs are used, (see Fig. 3 at *b*) the flow can be in any direction. In tubular joints close fitting parts are necessary because clearances and capillary action control the flow of the alloy. A few thousandths of an inch is all the clearance needed.

The advantages gained in preplacing silver brazing alloys are many and among the most important are:

1. Controlled cost per joint without waste or loss of alloy.
2. Assurance that the brazing alloy will fill and wet the total joint area.
3. Temperature control—melting of alloy is a definite indication of proper brazing heat.
4. Better appearance—uniform melting and no run-off to mar joints.
5. Better, faster heating—operators can devote all their attention to it—a big advantage in restricted places.

Fig. 2—A typical brazing alloy ring application. When pre-placed (as shown) a little pressure helps in obtaining the best bond.

Methods of heating work to be brazed with low temperature silver brazing alloys have received a great deal of attention recently. Improvements are constantly being made in heating methods and the one selected depends upon such factors as quantity of work, size of units, whether the work is to be done in the shop or field.

Torch Heating

The most widely used heating method is the oxy-acetylene torch. Various fuels are available such as city gas or natural gas and oxygen, gas and air; but oxy-acetylene, because of its clean, efficient heat, is by far the most widely used. Recent developments of multi-flame tips have increased the efficiency of gas heating by speeding up production and reducing rejects caused by poor heating. For brazing heavy flanges or other types of massive sections, a torch as shown in Fig. 4, has been found satisfactory. A multi-flame torch for smaller parts is shown in Fig. 5. Other torches with more than two tips are being used satisfactorily where rapid heating is required. On one production set-up a special multi-flame header with six No. 3 tips has proved effective. This special tip, because of the high heat developed, is water cooled to eliminate pre-ignition of gases. Single and multi-flame tips are available for various combinations of gases. Where a large number of units are to be brazed, specially designed multi-flame tips have been found helpful in providing better and faster torch heating.

Dip Brazing

This method is used in two different ways: the metal bath and the chemical bath. The metal bath is best suited to joining comparatively small work and is being used successfully in joining light gauge wires. The chemical bath, of late, has received considerable attention. This method requires that parts be supported in suitable jigs and brazing alloys are usually preplaced. It's a fast way of heating and, at the same time, provides protection from the oxidizing effect of the atmosphere. Brazing temperatures are readily controlled. This method of heating is still in the development stage and holds promise on certain types of work.

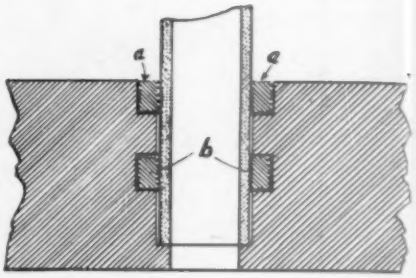


Fig. 3—Pre-placed alloy as used in making tubular joint to base plate. Two different schemes are shown. A few thousandths of an inch clearance is all that is needed.

Equipment similar to that used in salt bath annealing and heat treating is being used for brazing operations of this kind.

Electrical Methods

Electrical heating divides into three classifications—arc, induction and resistance. On an increasing number of operations where joints to be made are medium or small in size, it is a fast, clean way of heating.

In arc brazing, heat is obtained from an electric arc formed between the base metal and an electrode, or between two electrodes. This method at present is not used extensively for silver alloy brazing. It is, however, being applied successfully to the joining of light gauge copper with a silver brazing alloy as a brazing metal.

Induction heating is comparatively new as a means of heating for brazing operations. The type of equipment required will vary according to the volume and kind of work to be done. Joints made by this method are usually designed with the brazing alloy preplaced. Heating is uniform and readily controlled. It works very well where it is desirable to keep the heating localized. Induction equipment for melting and heat treating has developed rapidly in recent years. Makers of such equipment can help in determining units suited to brazing operations.

Resistance heating has been in use for many years. Heat is obtained by passing an electric current through the area to be brazed. On flat brazing work it is very effective and it is used considerably. It has also been applied to tubular shapes. There are two general types of resistance heating: one in which heat is generated in electrodes and transferred to the joint by conduction and another where heat is generated in the joint members. The first

Fig. 5—How a multi-flame torch is used in brazing small parts.

method is generally known as incandescent carbon heating because the heat is generated in carbon electrodes. Equipment is available in portable and stationary types. The brazing alloy is generally preplaced, but can be fed by hand. This equipment can be used on field work, as it is made up in portable types with electrodes mounted on tongs. In some plants spot welders have been converted for this work, using carbon and graphite electrodes, although electrodes made from tungsten or other high-resistant alloys can be used. Transformers with secondary voltages suitable for the electrodes used are required. A typical example of such an application is shown in Fig. 6.

Resistance heating, where heat is generated in the joint members, has not been so generally used. Joints have been made, however, on sheet copper, using thin inserts of silver brazing alloys without materially affecting the strength of the metal.

Furnace heating is growing as a means of applying silver brazing alloys, where size of work and volume are such that purchase of equipment of this kind is warranted. Furnaces are heated by oil, gas or electricity. With this method of heating, entire assemblies are brought above the flow point of the brazing alloy. Usually a non-oxidizing atmosphere is to be preferred and heating is done as rapidly as possible. This makes it desirable to run furnace temperatures considerably above the flow point of the brazing alloy and to regulate time in the furnace so that parts are not overheated, but stay in the furnace only long enough for the brazing alloys to flow completely. On large work temperatures must be lowered nearer the flow point of the alloy, due to the length of time work must be kept in the furnace to heat thoroughly. Brazing alloys are usually preplaced and even though the atmosphere is non-oxidizing, a little flux helps the flow of alloy. Furnaces of many types and sizes are available.

New Applications

There has been considerable development in the application of silver brazing alloys to cutting tools. An alloy* is now widely used for joining cemented carbide tips to tool shanks. Inserts of this alloy are usually placed between the tip and the tool holder. A low temperature flux is used. The operation is a simple one that can be done in any shop equipped with a torch for heating. Where the number of tools to be brazed is large, furnace heating is also being used. The tips are generally wired in place.

Fig. 6 — Typical example of electrical resistance brazing, carbon, tungsten or other high-resistant alloys can be used.

Fig. 7—Several types of brazed bus-bar applications. There is no greater voltage drop in the joint than in the metal.

Another development of the year has been the increased use of silver brazing alloys on electrical bus-bar systems. On this work a low temperature alloy,[1] joins the copper to copper without any greater voltage drop in the joint than in the metal. It also eliminates the need of servicing to remove oxides from joints and, due to the high strength of the joint, reduces the amount of copper required. Figure 7 shows several types of applications. This alloy is now being used to make ground connections in power plants and its use in electrical work generally has increased considerably, especially in making of reliable con-

*Easy-Flo No. 3. (1) Sil-Fos.

(Continued on page 34)

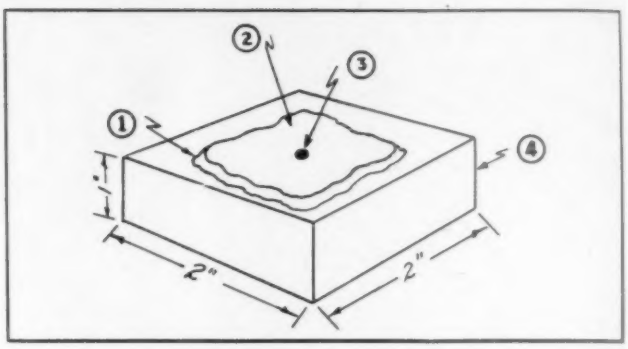


Fig. 4—Size of test block used in comparing hardness of overlays welded to mild steel—(2) Welded on overlay (3) Brinell impression in center (4) Mild steel test block.

Analysis of fundamental factors

Hard-Facing Technique

★ Part 2—Results of tests made to determine variation in hardness of facing with method of application — Ferrous alloy and non-ferrous alloy specimens were tested

By T. B. JEFFERSON

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THE USE OF HARD-FACING has given rise to the question as to which welding process will produce the hardest deposit. In Part I* we learned that, due to inherent metallurgical characteristics, the hardest deposits were those of the diamond substitute hard-facing materials followed by the ferrous alloy and the non-ferrous alloy materials. It was also pointed out that the diamond substitute materials were embedded in the base metal, but otherwise unchanged when deposited. For this reason the method of application has little effect upon the hardness of the diamond substitute deposit; however, it has been found that the different methods of application result in a wide variance in the ultimate hardness of the ferrous alloy and non-ferrous alloy hard-facing materials. To actually determine effects of method of application upon ultimate hardness of a deposit it was decided to test a number of specimen deposits of hard-facing material of the ferrous alloy and non-ferrous alloy groups.

To insure that the results of these tests and subsequent tests on hard-facing materials, which will be described later, would be unaffected by base metal dilution all overlays were made on uniform base metal blocks. In this manner dilution would be uniform in all cases and consequently would not affect the results. These test blocks were 2 in. x 2 in. x 1 in. pieces, Fig. 4, which had been sawed from a 1 in. x 2 in. hot-rolled mild steel bar.

The chemical and physical characteristics of this bar were as follows:

Chemical Analysis:

Carbon	0.18%
Manganese	0.45%
Silicon	0.07%
Phosphorus	0.04%
Sulfur	0.05%

Physical Properties:

Yield Point	29,900 psi.
Tensile Strength	60,440 psi.
Elongation	31.2%
Reduction in Area	55.0%
Brinell Hardness Number	120 B.H.N.

Inasmuch as all of the test blocks were obtained from the same steel bar it can be considered that all hard metal depositions were made on the same base metal blocks. Similarly, it can be assumed that the ultimate hardness of the deposit has not been affected to any noticeable extent by the base metal. Prior to depositing the hard-facing materials on the test blocks, each block was cleaned by grinding. In this manner all of the loose scale, rust and other foreign particles were removed from the surface to be welded.

In the depositing of hard-facing materials, special welding procedures are required to insure satisfactory results. There must be good fusion between base metal and overlay; yet the penetration during deposition must not be so deep as to cause a mixing of the two

*Part 1 was published in the December, 1939 issue, pages 37-39.

materials. Likewise, extreme care must be exercised to avoid blowholes, gas pockets, slag inclusions and similar conditions which will have a detrimental effect on the overlay.

In the preparation of the metallic arc specimens both bare and coated 3/16 in. hard-facing electrodes were used. They were deposited in accordance with their manufacturers' recommended current, voltage and polarity. The weld beads were run with the electrode held at an angle of approximately 30 deg. from vertical and about the normal angle against the direction of welding. Deposition was made with the weaving motion customarily used in flat welding. The speed of travel was just fast enough to keep the slag from getting ahead of the arc. During the test care was taken to float all of the slag from the molten metal to prevent slag inclusions.

Oxy-Acetylene Technique

The application of hard-facing materials by the oxy-acetylene process also requires special technique. The first step in the application is the heating of the base metal until it is molten. Then using a carburizing flame, with the excess acetylene streamers approximately twice the length of the inner cone, place the rod directly into the molten pool and begin the application. Both the rod and the flame should be held at angles approximately 45 deg. from vertical. The rod should be worked ahead of the flame. During the application the torch should be moved in semi-circles, so that the flame in addition to depositing the rod and melting the base metal is also preheating an area ahead of the deposit. Sufficient heat must be used to insure a good bond and the rod should be kept well back into the crater at all times.

The carbon arc specimens were prepared in a manner similar to that used in preparation of metallic arc specimens. In this application the carbon rod which is affixed in the electrode holder is held at an angle of approximately 30 deg. from vertical. The hard-facing rod is fed into the arc at an angle of about 60 deg. from vertical. The usual weaving motion used in flat position welding is used throughout the procedure.

The hardness of various specimens was determined by means of the Brinell test. This means of determining the hardness came into common use soon after its introduction by the Swedish engineer, J. A. Brinell[1], in 1900. In this test the hardness of a material is determined by its ability to resist penetration of a small steel ball.

Definition of Hardness

Before becoming too deeply engrossed in results of numerous tests that have been undertaken in preparation of this material, it may be well to consider for a moment the subject of hardness. Hardness is defined by Williams[2] of Amherst College, as the ability of one body to penetrate another. It is not believed however that this can be considered as an absolutely true definition for hardness in all cases. For example, Barcus[3] states that: "Hardness, aside from its practical importance, is one of the most remarkable properties of solid matter. This is shown at once by the difficulties which have been encountered in the endeavor to arrive at an accurate interpretation of it. Indeed, the attempts to solve questions relating to hardness are of very great variety, and are exceptionally numerous. They have in a measure led to some interesting results; but the subject in its broader aspects has not been attacked with success, nor has a rigorous definition of hardness been established." While this statement was made nearly 50 years ago, physicists and engineers are still searching for a means of determining "absolute hardness." For this reason the hardness values obtained in the tests contained in this series should be considered as relative hardness of the hard-facing materials involved.

Two hard-facing rods of commercial manufacture; one from the ferrous alloy group and the other from the non-ferrous group, were used in this test to determine if the method of application had any effect upon hardness of deposited hard metal. This series of tests were designed to serve as a preliminary study and forms a basis of the entire series to be covered in "Hard Facing Technique." The specimens in this series were prepared by depositing hard-facing on standard test blocks by the following welding methods: (1) Metallic arc process, (2) oxy-acetylene process and (3) carbon arc process. The series was divided into two sets of specimens; one in which the overlays were made on blocks which were at room temperature, while the other set of blocks were held at a cherry red heat (about 1500 deg. F.) during application of hard metal. Results of these tests are given in Tables 2 and 3, and pictured graphically in Fig. 5.

Those specimens produced by the oxy-acetylene process of welding were the hardest irrespective of type of

[1] J. A. Brinell, 1900, Communications Congres International des Methodes d'Essai des Materiaux Construction, Paris, Volume 2, pages 83-94.

[2] S. R. Williams, January, 1937, Hardness and Hardness Measurements. Instruments, pages 12-14.

[3] C. Barcus, 1891, On the Absolute Measurement of Hardness. Smithsonian Report, Miscellaneous Documents of the House of Representatives, 1st Session, 52nd Congress, Volume 43, pages 207-236.

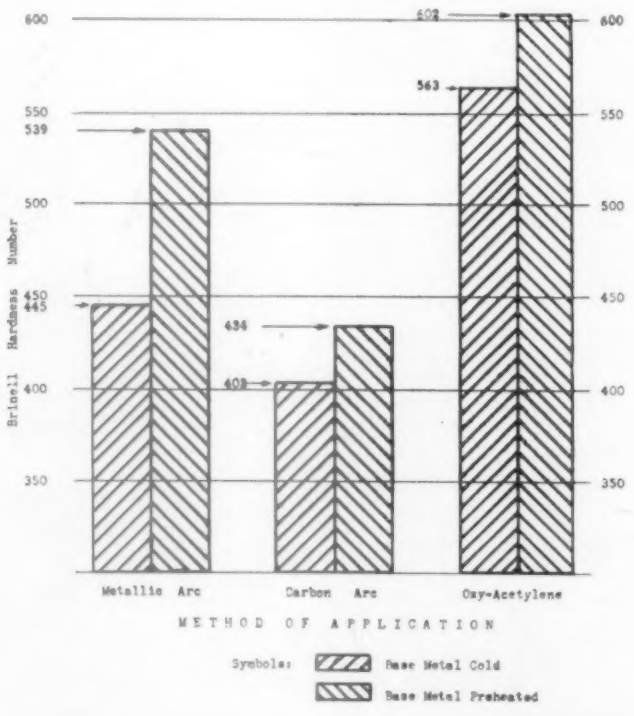

Fig. 5—Comparison of Brinell hardness of overlays as deposited by metallic arc, carbon arc, and oxy-acetylene.

TABLE 2—Effects of Methods of Application Upon Hardness. (Cold Test Block Specimen)

Specimen No.	Type of Specimen	Brinell Number	Remarks
100	Single Bead Metallic Arc Deposit.....	444	Ferrous Alloy
101	" " " " "	477	" "
102	" " " " "	444	" "
103	" " " " "	415	Non-Ferrous Alloy
104	" " " " "	444	" " "
105	" " " " "	444	" " "
Average	.....	**445**	
106	Single Bead Carbon Arc Deposit.....	388	Ferrous Alloy Straight Pol.
107	" " " " "	415	" " " "
108	" " " " "	341	" " Reverse "
109	" " " " "	388	Non-Ferrous " "
110	" " " " "	444	" " Straight "
111	" " " " "	444	" " " "
Average	.....	**403**	
112	Oxy-Acetylene Deposit.....	555	Ferrous Alloy
113	" " "	601	" "
114	" " "	578	" "
115	" " "	578	" "
116	" " "	555	Non-Ferrous Alloy
117	" " "	514	" " "
Average	.....	**563**	

TABLE 3—Effects of Methods of Application Upon Hardness. (Hot Test Block Specimen)

Specimen No.	Type of Specimen	Brinell Number	Remarks
201	Single Bead Metallic Arc Deposit.....	601	Ferrous Alloy
202	" " " " "	601	" "
203	" " " " "	477	Non-Ferrous Alloy
204	" " " " "	477	" " "
Average	.....	**539**	
205	Single Bead Carbon Arc Deposit.....	477	Ferrous Alloy Straight Pol.
206	" " " " "	429	" " " "
207	" " " " "	415	" " Reverse "
208	" " " " "	415	" " " "
Average	.....	**434**	
209	Oxy-Acetylene Deposit.....	601	Ferrous Alloy
210	" " "	627	" "
211	" " "	578	" "
212	" " "	601	" "
Average	.....	**602**	

welding material or temperature of base metal. Average hardness of specimens deposited by the oxy-acetyene process was increased 39 Brinell points by overlaying the hard-facing material on preheated base metal.

It was found that the next in hardness to the oxy-acetylene specimens were those produced by the metallic arc process. The ferrous alloy deposits on the "red hot" base metal were the hardest (601 Brinell). Likewise the ferrous alloy specimens averaged 124 Brinell points higher in hardness than the non-ferrous alloy specimens.

The specimens made by the carbon arc process were the poorest with regards to hardness of deposit. None of these specimens exhibited hardness comparable to that produced by either the oxy-acetylene or the metallic arc processes. It will also be noted that carbon arc specimens having the hard-facing deposited by straight polarity were harder than those obtained when using reverse polarity. This was attributed to the fact that when using reverse polarity the flow of current is from the carbon electrode to the base metal, resulting in a serious dilution of the hard-facing deposit by the base metal.

The results of this series of tests indicate that hard-facing materials deposited by the oxy-acetylene method will show higher hardness characteristics than might be obtained by the use of either the metallic arc or carbon arc processes. It is not believed that these results can be considered conclusive in view of the small number of specimens obtained. It can be definitely concluded, however, that:

1. Hard-facing materials deposited on surfaces which have been preheated will be harder than those made on cold base metal surfaces.

2. Deposits of hard-facing made by either the oxy-acetylene or the metallic arc welding processes will exhibit higher hardness properties than those made by the carbon arc process.

3. The metallic arc process is most satisfactory from standpoint of speed of deposition of metal.

In the third article of this series there will be shown the effect of the acetylene flame upon hardness of deposit of hard-facing materials.

» «

SILVER-ALLOY BRAZING

(Continued from page 31)

nections to lugs, leads and taps of all kinds.

Silver brazing alloys have also shown a healthy growth in joining alloys such as stainless steel, beryllium copper, aluminum bronze and K Monel. These metals are being joined with a low temperature brazing alloy* which flows freely at 1175 deg. F. and which is also being used to joint dissimilar metals.

With the use of silver alloy brazing expanding rapidly, it can be said that there are possible uses for these alloys wherever there is metal to join. While refrigeration, air conditioning and electrical work still comprise the largest uses, miscellaneous applications on a wide variety of equipment are growing fast. For example, the past year has seen a number of applications started in the automotive industry, where these alloys are being used in making oil filters, gear shift levers, frames for no draft ventilation, radiator grilles, etc. Among many other applications, oil coolers and spark plugs are being silver brazed for airplane service. Silver brazing alloys are doing a neat, economical job for makers of metal furniture and kitchen utensils. Hard-faced valve seat inserts are being brazed in valve bodies and large quantities of pipe and fittings are being brazed with silver alloys on marine work.

*Easy-Flo.

Fig. 1 — Function of this earth-moving "Angledozer" (mounted on a tractor) depends upon the curved lines and irregular shaped parts which are made practical by mechanical flame-cutting of steel plate.

Arc welding
economies made possible by

Machine Flame-Cutting

★ Permits greater freedom of design—Streamlining of parts permits better functional design—Production is speeded up using flame-cut parts

By ELMER E. ISGREN and WALTER J. BROOKING
Plant Superintendent and Member of Engineering Department, respectively, of R. G. Le Tourneau Inc., Peoria, Ill.

ONE OF THE MOST important servants of arc welding, as it is known and applied today, is the mechanical flame-cutting process. Much of the great freedom of design which attends the arc welded method of fabrication is the direct result of the ability to cut pieces of almost any size and shape from standard rolled steel plate, with mechanically-controlled and guided oxy-acetylene cutting torches.

The streamlined curves of today's most progressive machine designs, illustrated by the earth-moving "Angledozer" which mounted on a tractor as shown in Fig. 1 would be practically impossible to achieve without some economical and practical means of cutting the curved plates and odd-shaped members which actually determine the form and lines of the machine. Figure 2 is a phantom diagram of the "Angledozer" shown in Fig. 1, seen from a different angle, with all of the parts which were mechanically flame-cut shown in black. This clearly demonstrates how the flame-cut plates actually form the outline of the machine and therefore largely control the outline of the structures which make up the complete assembly. The smooth, easy-flowing lines of the different members combine a maximum effectiveness in the function of the machine with the most compact, strongest, most rigid and lightest design known in the manufacture of modern machinery.

The arc-welded earth-moving scraper and tractor shown in Fig. 3

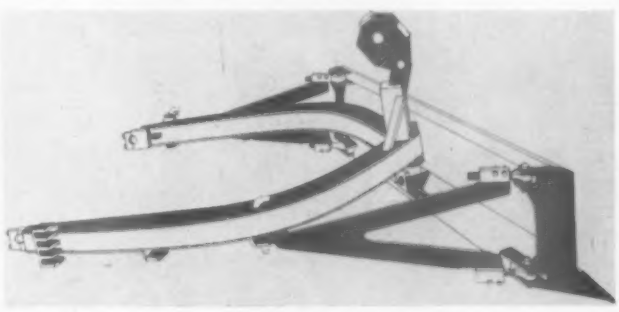

Fig. 2 — Phantom diagram of machine in Fig. 1 showing in black every part which was flame-cut.

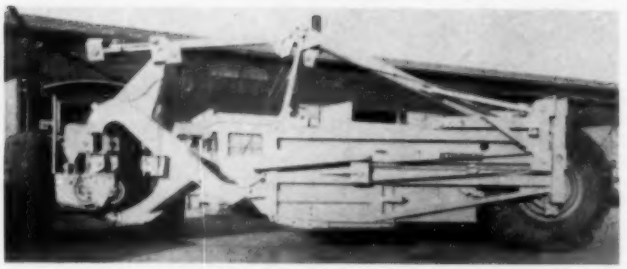

Fig. 3—Without mechanical flame-cutting the economical production of machines like these would be impossible.

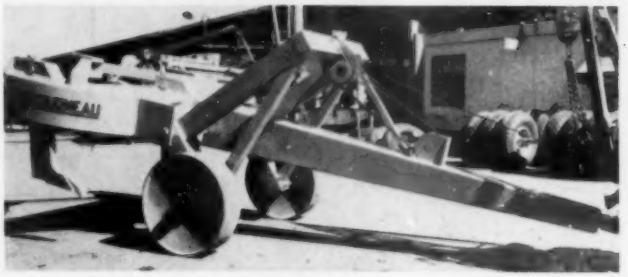

Fig. 4—An earth and rock ripping "Rooter." The main body is of 1 in. steel plate. All irregular parts were mechanically flame-cut to shape.

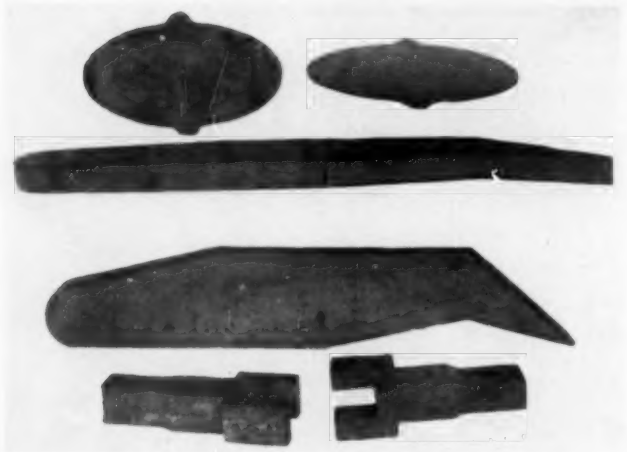

Fig. 5—Plates from 20 gauge to 10 in. thick can be flame-cut mechanically.

further illustrates the freedom of the designer to make machinery which embodies the greatest functional value with the least material by the flame-cut and arc-welded process. The entire machine, consisting of the cable-controlled 18-yard capacity scraper, the tractor (excepting the motor), and the power control unit is a regular product made on a production basis from standard rolled sheets, plates and bars which are flame-cut, sawed, sheared, formed or shaped and then unified by arc welding. There are no castings in the entire unit except for the motor (which is purchased as a unit).

The exacting demands of duplication and accuracy of reproduction involved in the manufacture of such machines are met economically by the mechanical flame-cutter. For the large, curved plates so evident in the above design, the flame shape-cutting machine is very practical. By using a templet which can be set up in a short time, shapes may be cut from plate, one to four at a time, in as large a quantity as is desired. Each is essentially an exact duplicate of the other. The flame-cut edge is sufficiently smooth and clean to fit accurately and can be welded without further processing, a thing which is impossible to do economically by any other method or machine. The precision required in cutting many of the gears and the smaller parts of the tractor, power control unit or scraper can be achieved nicely with the mechanical flame-cutter. Machinable tolerances can be held regularly if the templets, machine and workman's care are all properly applied to the job.

Saves Production Time

Another very important contribution of mechanical flame-cutting to the arc welded fabrication process is the speed with which parts may be cut from plate as compared to any other means. Figure 4 shows an arc welded heavy duty "Rooter" used for ripping up earth and rock. This machine was laid out and drawn in the engineering department, the parts cut and welded together, the machine assembled and painted and was being tested, all within the short period of less than two weeks. The number of curved and odd-shaped parts which can be seen readily indicate the part the mechanical flame-cutter played in the quick development of this experimental machine. Many parts were simply drawn and then traced with a shape-cutter from a temporary templet.

The wide range of capacity of shape-cutters makes it readily adaptable to almost any arc welded fabrication which uses steel plate. Figure 5 shows a cap plate cut from ⅛ in. steel plate, a "Rooter" shank cut from 2½ in. plate and a universal blank cut from 4 in. plate. The actual limits of the capacity of the machine is less than ⅛ in. on the thin limit to over 10 in. thick. The cut made by a flame-cutting machine, Fig. 6, was through a 10 in. x 18 in. billet. Pieces as thin as 20 gauge have been flame-cut by stack cutting—placing many plates one on top of the others, clamping them together and flame-cutting them. Figure 7 shows the cutting of the small cap plates

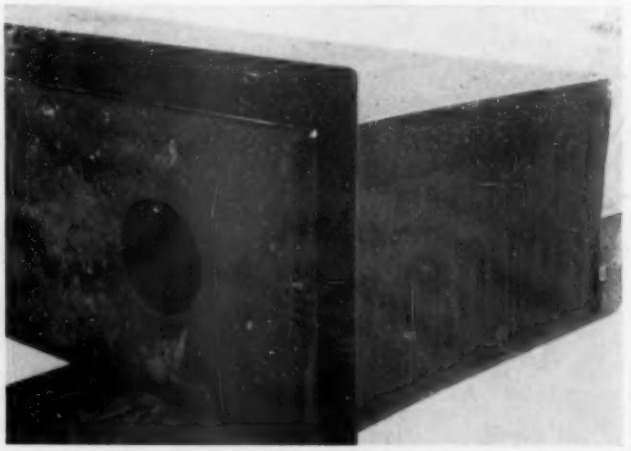

Fig. 6 — Smooth, accurate cutting of thick plate is demonstrated by the flame-cut face of this 10 in. x 18 in. billet.

Fig. 7—Stack cutting of irregular shaped parts from thin plates.

shown in Fig. 5. Thirteen ⅛ in. plates are clamped together, tack welded, and cut as if they were one plate. Parts may be flame-cut whose dimensions range from only a few inches up to 96 by 360 in.

The adaptability of flame-cutting as an economical, quick means of producing special parts such as the sprockets cut from the templets shown in Fig. 8 is often very important as a time and money saver. Such parts could be blanked out of plate, but a great number of the parts could be flame-cut for the cost of a blanking die. The blanking out of parts with a press is naturally limited to the ratio of press capacity and plate thickness and it requires heavier presses than many manufacturers have available.

Figure 9 illustrates application of flame-cutting to parts which are irregular and are formed or shaped after cutting. Many parts could be made from bar stock and fabricated by the building up of parts sheared or sawed from bar stock, but the savings made by flame-cutting an irregular shape from plate and pressing it to the desired form often eliminates enough welding to make it a profitable process.

Mechanical Flame-Cutters

There are three general types of mechanical flame-cutters, each of which is designed and more or less limited to a certain class of work. They are: (a) the portable (or tractor) flame-cutter, (b) the magnetic type flame-cutter, and (c) the multiple-flame shape-cutting machine. The function and application of each type of machine is as follows:

A. *Portable (or Tractor) Flame-Cutter.*

A portable flame-cutter such as is shown in Fig. 10 is readily adapted to long flame-ripping jobs where a long cut on a straight line is necessary. It operates on a rail for such jobs, and has the advantage of a mechanical regularity of cut and uniformity of production. Long bevelled members and long scarf cuts for welding can be made in the same manner as a long straight cut by tilting the torch of the tractor flame-cutter to the desired angle.

The other general use for the portable machine is that of making small, localized cuts, (either along straight lines or with a radius rod) on heavy plates. The small machine can be taken to the large, thick plate, such as the 2½ in. x 20 in. x 99 in. plate as shown in Fig. 10. The cut can be made without removing and transporting the whole plate to the cutting machine, and then having to rehaul and repile the plates after the small piece of the desired shape is removed.

(Part 2 will be published in the February, 1940 issue.)

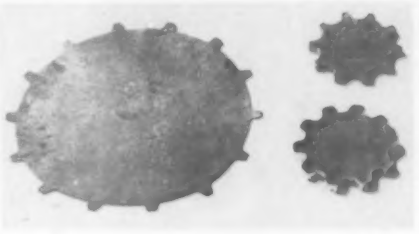

Fig. 8—Parts cut from steel plate to make an emergency repair

Fig. 9 — Parts cut for pressing or shaping. The bowl was a 38 in. disk cut from 1½ in. plate and pressed hot. The other parts are irregular shapes cut from ¾ in. plate.

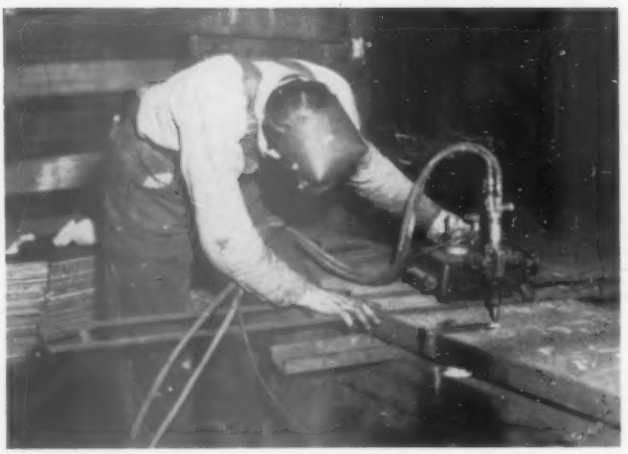

Fig. 10 — A portable flame-cutter on the job.

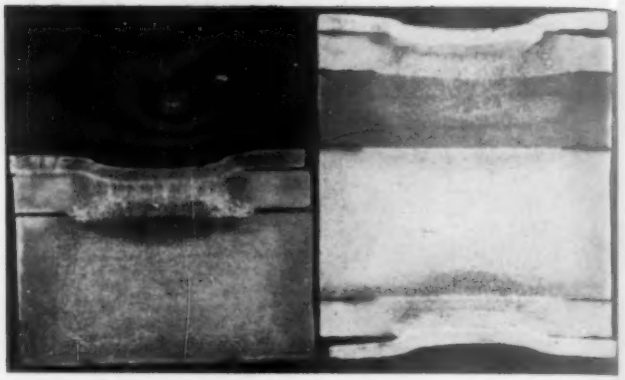

Fig. 1—Etched sections of spot welds through various thicknesses of steel plate, ranging from ⅛ in. to 1 in. Photo (General Electric Co.).

A condensed review of

Resistance Welding Progress

★ Accurate control of current is very important—Low-inertia of movable heads an advantage where material has short plastic range—Longer electrode life with interrupted spot welding

By R. T. GILLETTE*

Engineer, Works Laboratory, General Electric Co., Schenectady, N. Y.

WHILE RESISTANCE WELDING is over 50 years old, more progress has been made in the last 5 or 6 years than in the rest of its life in placing welding on an accurate scientific basis where it belongs, but a tremendous amount of work still remains to be done to secure and tabulate the accurate welding data so much needed at present.

The control of early welding equipment was all manual. It was soon recognized that this type of control was inadequate, particularly for the shorter time required to make welds as production speeds increased. The timing of current as applied manually was very erratic and inconsistent. Perhaps one of the earliest controls was the follow-through switch used, both on manual and mechanically-operated machines. This was inaccurate and gave considerable trouble due to non-synchronous switching and variable timing, and was superseded by the cam limit-switch contactor type of control. This was an improvement over earlier types of control and is still used extensively.

At about the same time various types of interrupters were used for seam welding, including mechanically-driven flapper switches, water pot interrupters and contactors driven by synchronous motors. There was a gradual improvement in this type of control, but there was still considerable difficulty in getting consistent first quality welds, particularly on non-ferrous metals and alloys, aluminum, stainless steel and combinations of dissimilar metals.

At this time the electronic or vacuum tube controls appeared with their attendant accuracy in timing which is as accurate as the frequency of the circuit in which they are used. They also close the circuit at the proper point on the voltage wave to eliminate transient conditions, are arranged to give infinite steps of heat regulation by the phase-shift control method, act as interrupter for seam welding and intermittent seam welding, and are used for interrupted spot welding which will be discussed in more detail. The electronic control is the most consistent control now available for resistance welding. It is sturdy, noiseless in operation and simple to use. This control has been one of the most important factors in the development of a great many welding jobs which were formerly considered difficult or impossible.

While the original cost of electronic control may be higher than the cost of some other types of control, its lower electrode maintenance cost, noiseless operation, accuracy, flexibility, synchronous switching and the extremely low rejection of parts due to faulty welding more than justifies the difference in original cost.

Electronic controls must be synchronous in operation, incorporating tubes to control and time the welder primary current, to be assured of all the advantages of this type of control. Non-synchronous electronic timers which control a contactor do not show any improvement in quality of weld or lower electrode maintenance over the

*This review is a digest of the author's paper read at the last annual meeting of the American Welding Society.

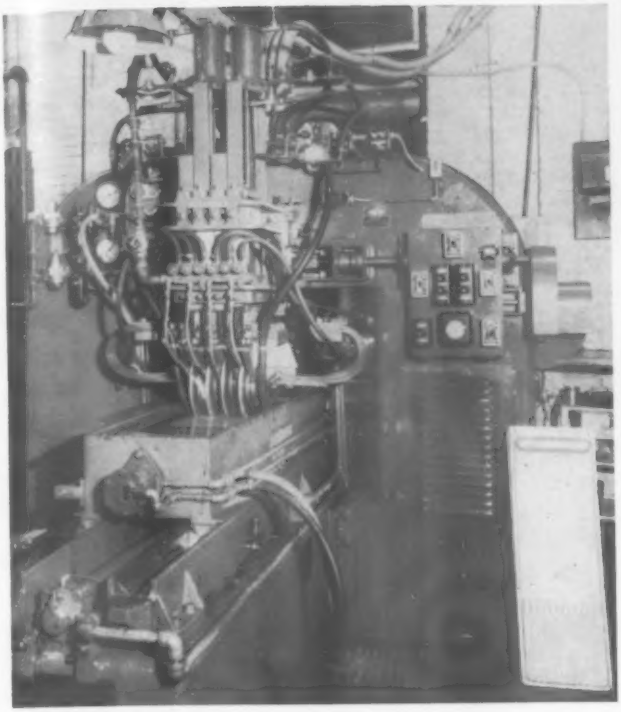

Fig. 2—A high production seam welding set-up using 4 rolls for intermittent seam welding of stainless steel evaporator used on G.E. refrigerator. Welded under water for quick dissipation of heat.

cam-operated limit-switch contactor control.

Ignitron tubes which are essentially single-pole electronic contactors may be used to control the primary current of a resistance welder, but there is no synchronous timing included. No external power is required as the tubes pass current when two terminals are shorted through a 3-amp. control switch which may be a limit or other type of switch, cam, air or otherwise operated from the welding machine. Current flow ceases when the control switch is opened.

The advantages over other types of contactors are:

1. No moving parts.
2. Will operate 1800 times per min. as easily as once per min.
3. Operates months without attention; no moving contacts to clean or replace.
4. Current flow always ceases at the zero point on the current wave.

When used with a non-synchronous timer the welds will probably be no better than those made with a magnetic contactor. Synchronous timing is required for improved welds, improved electrode life and accuracy of all control factors.

Spot Welding

Recent developments in spot welding equipment give us motor-driven, air or hydraulically-operated spot welders which are really machine tools. They are built like and operate as consistently as any machine tool and should be cared for and considered as a machine tool.

Another factor that has quite seriously affected spot welding is the inertia of the moving element or head, electrode and lead assembly. In making a spot weld, pressure is applied through the moving element, then current is switched on and as the metal softens to the welding temperature, the pressure on the electrodes must press the metal together to complete the weld.

When welding in very short time, particularly when welding a material of short plastic range, the time available to accelerate the moving element of a welder is very short. This factor is recognized and efforts are being made to keep the moving parts as light as possible and retain a sufficient amount of copper to carry current to the weld. The time left for pushing metal together in short time welding (½ cycle or less), after the metal has heated to the welding point, may be in the range of 1/500 to 1/750 of a second. If the pressure follow-up is too slow, burned work and high electrode consumption will result.

Another type of spot welding equipment is known as multimatic, speedmatic, hydromatic or ultra-speed. These are made for a specific job and weld a complete assembly with one handling. They may be equipped with as many as 150 spot welding points or stations. An assembly to be welded is clamped to the fixtures of a machine of this type and one or more of several types of welding may be used. All electrodes may be brought in contact under air, spring, or hydraulic pressure and the secondary current commutated from one pair of series or multiple electrodes to the other. This commutating is done with the current shut off and is only switched on while the commutating device is on one contact segment. The actual timing and switching is usually done with an electronic control. These machines may also have several transformers in operation at one time.

This type of equipment welds a complete assembly while it is rigidly clamped to a fixture. This reduces any distortion or misalignment to a minimum. This type of welding equipment may be constructed in an unlimited number of forms and combinations.

Interrupted Spot Welding

When spot welding heavy material ranging from 3/16 to 1 in., a great deal of trouble was experienced in electrode maintenance, when a continuous flow of current was used. To correct this condition the interrupted method of spot welding was developed. This consists of bringing the electrodes in

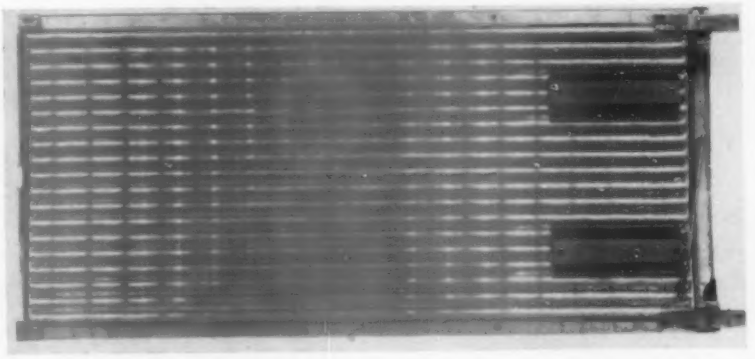

Fig. 3—Refrigerator condenser fabricated by resistance welding. For a G.E. Type CF machine.

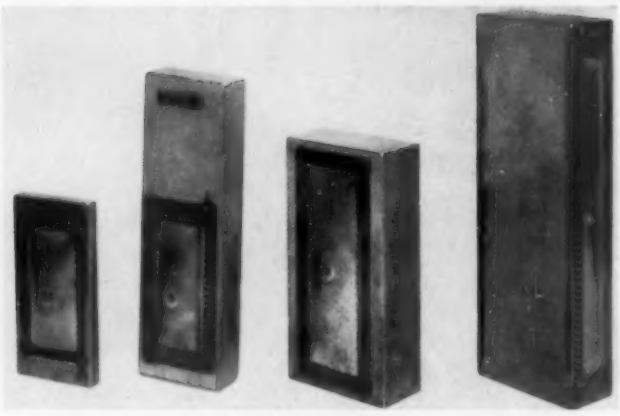

Fig. 4 — Examples of seam welding two pieces of dissimilar thicknesses. Specimens were tested to failure under hydrostatic pressure.

contact under pressure in the regular manner, then applying current in a series of impulses rather than continuously. A typical welding procedure might consist of 10 cycles on and 5 cycles off, repeated 10 times for a certain thickness of material for a certain job. The interruption of current allows a welding temperature to be built up in the weld without excessive heat in electrodes or surface of work piece. To take advantage of the interrupted method of welding, adequate water cooling of electrodes must be used. The electrode life is greatly lengthened by using this method. No definite figures are available but 100 to 1 ratio seems very conservative.

The interrupted method also gives much better heat distribution on heavy material, allows time for good forging action on the weld and if burning or spitting starts, the current interruption stops it and the next current impulse does not start it again. An annealing cycle can also be arranged by this method which is sometimes of advantage on alloy steels.

As an example, we might make a weld with 10 impulses of power, 6 cycles on and 2 cycles off, then after a dwell of 20 cycles off, one more impulse of 6 cycles may be used as an anneal or heat-treating application. Synchronous electronic control is of particular value in interrupted spot welding. This process can be made fully automatic, and at the same time, transients in welding current will be avoided which might build up current of two or three times normal value.

Seam Welding

There has been a very rapid development in seam welding technique and equipment in the last few months. While there is still a very definite need for the old standard seam welder with a wheel top and bottom, they are being replaced on jobs where large production and design of parts permits by multiple-wheel welders using the series system of welding; that is, placing two wheels above the work and with a properly designed fixture or conductor bar underneath the work, making two welds at one time.

Seam welders of this type are also used to make long rows of spot welds, as these machines are equipped with electronic interrupters. The only change necessary to make when changing from seam to spot welding is to set the interrupter for longer off time.

One of these welders makes spot welds between two pieces of an .025-in. stainless steel refrigerator evaporator with the following procedure: Pressure 1000 lb., 3 cycles on, 3 cycles off, 11,000 amp., wheel speeds 150 in. per min. With this procedure we get 4 spot welds per inch of travel of the work part or ten spots per wheel per second, a total of 2400 spot welds per minute per machine.

Another interesting seam welding equipment development is on a flat plate condenser made from two pieces of .037-in. low-carbon steel. This part has 20 parallel seams, a total of approximately 900 in. of weld. These parts were originally welded on standard manually fed seam welders, with a production of about 3½ pieces per hour. After several steps of development a seam welder was built, having ten welding wheels and five transformers, operating two wheels in series from each transformer with a splined shunting platen underneath. This machine is automatic in operation and has a production of one piece per min. The following is the welding cycle, 1050-lb. pressure, 120 in. per min., 2 cycles on, 1 cycle off, current 17,100 amp. Total kva. demand 1006, width of wheel faces, 3/16 in. to 5/16 in.

This machine is fully automatic with hydraulic drive and indexing, and is controlled with five fully synchronous electronic interrupters. The welds are all made while the condenser is immersed in water. This reduces distortion to a minimum and reduces wheel maintenance. The quality of the product is exceptionally good.

It has been thought that about two pieces of ⅛-in. material of like thicknesses were about the limit for satisfactory seam welding but our success with interrupted spot welding led us to have a seam welder built with an intermittent drive so the wheels would travel a fraction of an inch and stop while several impulses of power were applied, then advance a fraction of an inch and repeat several impulses of power.

By the use of this method satisfactory welds have been made on two pieces of 3/16 in., ¼ in. and ⅜ in. Two pieces of ½ in. were also tried but the equipment available was not of sufficient capacity to successfully weld two pieces of ½ in. It seems logical to believe that with proper

(Continued on page 51)

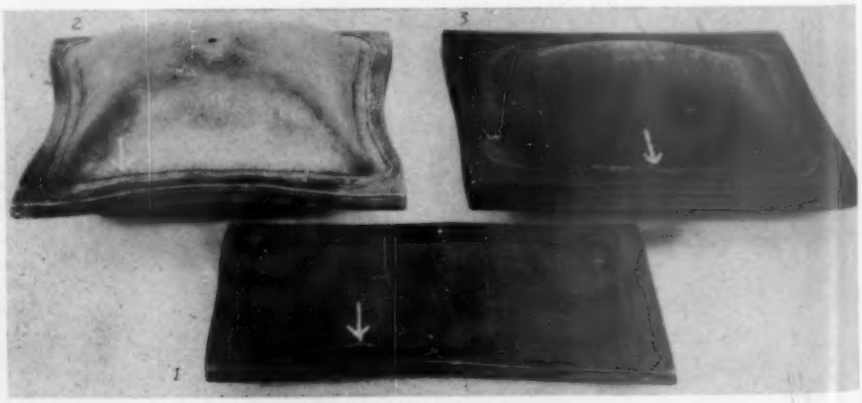

Fig. 5—Test samples of seam welds in fairly heavy steel plates. Under hydrostatic test each one failed at inner edge of weld as marked by arrow. (1) Two 3/16 in. plates; (2) two ¼ in. plates; (3) two ⅜ in. plates.

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Oil Field Welding Is Big Business, March, 24.
Oil Refinery Pressure Vessel uses welded carbon-molybdenum steel, July, 26.
Oil Well Drilling Bits, rotary and fish tail, hard-faced with tungsten carbide, Feb., 29.
Oxy-Acetylene Cutting Torch features new design head mixer, Sept., 52.
Oxy-Acetylene Development, review of; multi-flame tips increase speed of pipe line and casing welding, flame hardening and softening, flame conditioning, Feb., 26.
Oxy-Acetylene processes, applications in welded high-pressure piping, May, 17.
Oxy-Acetylene shape-cutting of oil field equipment parts, Aug., 33.
Oxy-Acetylene Welding, description of procedure, Jan., 25.
Oxy-Acetylene Welding Hose, Twinweld, Feb., 36.

P

Paint Pail Welder by National Electric, Oct., 39.
Panel Welding of railroad cars, Dec., 31.
Pipe Flanges, welded, reduce weight and eliminate drilling, Jan., 19.
Pipe, welded, important part of modern refinery, Aug., 31.
Pipe Welding simplified by fitting, Dec., 44.
Plow Sweeps, simple method for building, May, 34.
Pneumatic Grinder, portable, weighs only 18 oz., Sept., 65.
Portable Welder, "streamlined," effective advertising medium, Feb., 31.
Power Plant protected by welded "cage," June, 34.
Precision Welding by resistance method, Dec., 29.
Pressure Regulators, Grove air and gas, Jan., 37.
Prest-O-Weld welding and cutting equipment, Sept., 66.
Principles of Welding offered in special course at Rensselaer Polytechnic, Dec., 47.
Production Time saved by redesign of welded burner, Oct., 35.

Protect-O-Metal, aid to welding, Nov., 46.
Pulleys for rock belt conveyor system fabricated by welding, June, 34.
Pump, homemade, all-welded, March, 34.

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"Qualified Welder," A.W.S. definition of, Feb., 17.

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Radiographic Applications, discussion of trends in, April, 24.
Radius Holder, wedge-grip, Feb., 36.
Railroads cutting maintenance costs by adoption of welding repairs to manganese trackwork, Dec., 32.
Railway effects savings by fabricating on the job, Aug., 24.
Railway Motor Frames for Penn. R.R. arc welded to achieve economy, weight reduced to 12 lbs. per hp., Oct., 21.
Regulator for scarfing or de-seaming, Dec., 46.
Regulator Redesigned for supplying oxygen to air transport planes, March, 34.
Reinforcing Straps, suggestions for welding of, Feb., 34.
Resistance Welding, digests of selected A.W.S. papers, Dec., 28.
Resistance Welding, latest developments, Dec., 28.
Resistance Welding of thin gauge stainless steel tubing, July, 19.
Resistors, 500 or 1000 watt Ohmite, Dec., 45.
Riveting Machine, all-welded, April, 31.
Rotary Files, ground from solid blanks June, 37.

S

Safety Shield, all-purpose, introduced by Sellstrom, Sept., 65.
Safety Valve, automatic, for welding and cutting gases, July, 39.
Salt Tablet Dispenser, July, 38.
Sardine Purse Seiner built of welded steel, Aug. 37.
Scarfer Tooth, hard facing of, Feb., 31.
School in Pittsburgh prepares welders for heavy industries, April, 29.
Shipbuilding, problems of procedure control, quality work not always assured by welder's qualification tests, July, 23.
Ship Welding, high spots of, Nov., 39.
Shovel Dipper, dynamite-shattered, repaired by welding, June, 32.
Shovel Turntable Bed arc welded, Part I, Nov., 29; Part II, Dec., 20.
Silver Brazing joins dis-similar metals, April 32.
Silver Brazing of copper conductor arms, Oct., 34.
Silver Brazing of 6,000,000 joints without single failure, July, 37.
Silver Brazing of Stainless Steel, by use of proper fluxes, March, 28.
Snow Cruiser for Byrd Antarctic Expedition uses arc welded construction, Sept., 33.
Snow Plows welded, April, 33.
Spotting Weakness in "air bottle" design, Oct., 34.
Spot Welder with welding head, control and automatic switch in compact unit, July, 38.
Spot Welders, electric, bench type, Sept., 52.
Spot Welders, 50-KW Ace, Dec., 47.
Spot Welders vertical type made by Eisler, Oct., 38.
Spot Welding, application of portable, Dec., 31.
Spot Welding automobile grade mild steel, Dec., 30.
Spot Welding by use of seam welder, Dec., 36.
Spot Welding Gun mounted on extension handle, Nov., 46.
Spot Welding low carbon and stainless steels, Dec., 30.
Spot Welding of non-ferrous metals, pressure control in Sept., 62.
Spot Welding speeded up by home made "gun," Oct., 33.
Spot Welding Tip Dresses, introduced by P. R. Mallory & Co., Sept., 52.
Spot Welding Tips, new holder for, Sept., 54.
Spot Welding with hydrogen gas atmosphere, April, 35.
Spud for Dredge straightened by simple method, Aug., 36.
Stainless Steel new procedure suggested for welding of, Oct., 37.
Stainless Steel, thin gauge, welding ornamental eagle, Nov., 43.
Standard Structural Shapes for simplified designs, Aug., 29.
Stator Frames, special fixture aids welding of, April, 28.
Steel Barges, welded have greater carrying capacity, June, 35.
Steel Castings, use of, in welded fabrication, Nov., 36.
Steel Castings repaired by welding and flame-cutting, Nov., 37.
Steel Irrigation Pumps, welded, becoming popular, Dec. 42.
Steel Mill Equipment, service life prolonged by hard-facing, alloy surfacings effect savings, efficient applications made with oxy-acetylene process, March, 25.
Steel Pipe, welded, takes severe punishment, Aug., 30.
Steel Plate, forming by flanging machine for welded fabrication, June, 23.
Steel Ry. Trestle first arc-welded, built by Fla. East Coast Ry., July, 21.
Steel Rims changed over to pneumatic tires by simple welding operation, Oct., 37.
Steel Sheathing, welded, applied to decks of wooden barges, Oct., 36.
Steel shrinkage corrects distortion, Nov., 34.
Steel Tanks welded, for underwater floodlights, April, 30.
Steel, welded, for reinforcing large concrete pipe, July 18.
Steel Welding, structural, data to help in design and fabrication, April, 17.
Stone Crusher built by welding flame-cut plates, Nov., 28.
Studs, broken, how to remove March, 35.
Structural Rolled Shapes, new designs recommended for, June, 30.
Submarine Pipeline, welded, will supply gas to Treasure Island, Jan., 35.
Subway, Chicago, welding and cutting, Jan., 32.
Sugar Cane harvested by welded machine, April, 28.
Sweatband inexpensive, Dec., 45.
Syncro-Break Welding Contactor Feb., 36.

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Tank Construction, joints used, Jan. 25.
Technique of Arc Welding, overhead butt welds, repairing cast iron, welding stainless steel and aluminum, Jan., 30.
Test Specimens, types required for A.W.S. qualification, Feb., 17.
Thermal Forces alone will straighten bent steel sections, Aug., 36.
Thermit 4000 lbs., used on welded punch press, April, 33.
Thermit Welded Rails used by street railway, Oct., 33.
Threads, repair of damaged, June, 34.
Tow Boats, all-welded, built by Dravo Corp., May, 22.
Tractor Parts, resistance welded, replace castings and forgings effect important savings, Sept., 58.
Tractor-Strip, made by Marquette, May, 36.
Trailer redesigned for all-welded steel construction, cuts production cost 20%, Sept., 70.
Transformers for Electric Resistance Welding, Feb., 22.
Transformer Type A-C Welder, developed by Owen Electric, Oct., 38.
Traversing Machine for automatic arc welding, April 23.
Trepanned Plugs used to inspect welds, Nov., 38.
Truck Chassis shortened by aid of welding, April, 30.

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Underwater Cutting Torch Solves Another Problem, March, 32.

W

Welded Beaching Gears for Trans-Atlantic Passenger Planes, March, 35.
Welded Cable Saddles substituted for castings in new Tacoma bridge, details of design and shop fabrication, Oct., 24.
Welded Framework used for float in "tournament of roses" parade, March 35.
Welded High-Pressure Piping, applications of oxy-acetylene, superiority of "back-hand" welding, May, 17.
Welded Ladles show weight saving for steel plant, Jan., 34.
Weld Cleaning Time reduced by Spatter-Nox, July, 38.
Welded Equipment, fabrication of large, Nov., 35.
Welded Land Leveling Equipment May, 32.
Welded Offset saves extensive rebuilding job, Dec., 42.
Welded Pipe Joints Unbroken, withstand hurricane, Feb., 33.
Welded Railing Is Ornamental, March, 32.
Welded Railing used at San Francisco beach, April, 31.
Welded Road Grader, long cutting knives used on, Jan., 35.
Welded Sphere to store hydrogen Nov., 43.
Welded Steel Buildings, trend is toward (Part I) savings effected by use of welded designs, May, 24.
Welded Steel Buildings, trend is toward (Part 2) easier shop assembly, savings in erection costs, June, 26.
Welded Steel Coal Barge Withstands Severe Battering, March, 32.
Welded Stoves Made from Steel Drums, Feb., 32.
Welder-Artist Has Unique Hobby Feb., 32.
Welder Checkmates Malicious Tampering, Jan., 33.
Welder constructs giant shoe, July, 35.
Welder fabricates shield for oil well pump, Nov., 42.
Welder's Chipping Hammer, Feb., 35.
Welder's Chipping Hammer, June, 37.
Welder's Glove, improved type of Sept., 54.
Welder's Helmet, "Cesco" twin-view, May, 36.
Welder, portable, mounted on truck, Jan., 36.
Welder, U.S.L. 500-amp. A-C, Dec., 46.
Weld Filler by Northeast Metals, Sept., 51.
Weld-Flux Chipper, April, 35.
Welding Fittings, new proposed standards for, Am. Soc. Mech. Eng., May, 20.
Welding Generators; more floor space gained by clever grouping, Jan., 34.
Weld Grinding Equipment, factors which govern selection of, (Part 1) wheel types and speeds for stepping up production, techniques in polishing welded surfaces, types of flexible shaft equipment, May, 28.
Weld Grinding Equipment, factors which govern selection of, (Part II) comparative costs, spark hazard, polishing stainless steel, June, 28.
Weld Hardening, Nov., 33.
Welding Comes of Age, review of technical advances, Oct., 30.
Welding Engineering Course offered by Ohio State, June, 22.
Welding in steel mill, Nov., 36.
Welding Hose, Manhattan Duplex, May, 35.
Welding Machine, new 200-amp., can be hooked up in parallel, Sept., 54.
Welding Unit, double-duty gas and electric, July, 38.
Welding Lens, pneumatically-operated, April, 36.
Welding Outfits, by Imperial Brass, Sept., 68.
Welding Rod, known as Amsco "Dieweld," Sept., 50.
Welding Shields of one-piece construction, C. H. Dockson Co., Sept., 51.
Welding, stainless steel and aluminum, Jan., 30.
Welding Torch, with 13 nozzle sizes, Sept., 54.
Welding versus Prejudice, test prove plate material more important than weld, Aug., 26.
Weld Timer and Contactor, Dec., 44.
Wiping Cloth, chemically treated, for safety goggles, May, 36.
World's Fair to have welded whirligig, June, 35.
Wooden Decking Supports replaced by welded "I" beams, Oct., 36.

X

X-Ray Machine, portable, makes flaw detection easier, April, 31.
X-Ray Photos, improved by metal shot, May, 33.

Z

Zinc-Base Alloys, welding of, June, 21.

Welded butane tanks mounted on skids. Photo (Leader Iron Works, Inc.).

Spot Welding Thin Lead Sheet To Tin Plate

★ A report recently issued presents results of an experimental development project conducted by P. R. Mallory Inc., Indianapolis, Ind., on the subject of spot welding lead sheet (.062 in.) to tin plate (.020 in.). Figure 1 shows the electrode arrangement which produced the most satisfactory welds. Electrodes were carefully aligned and efficiently water cooled. Test data indicated that the following welding valves gave best results:

Current timing .....7 cycles
Total electrode pressure..120 lbs.
Power input .....25 kva.

The welds made under the above conditions pulled slugs from the lead sheet when torn apart. Indentation of the tin plate was encountered but not seriously objectionable. There is a lead flash at the interfaces of the sheets and is due to the wide difference in physical properties of the two metals. It is believed, from a practical standpoint, impossible to completely eliminate the feathering of the lead at the interfaces. However, the flash may be reduced to a minimum by proper adjustment of welding conditions.

It is essential for a minimum of feathering at the interfaces, that the interfaces of the sheets be smooth and parallel before welding. It was found that cleaning the lead surface and coating it with a thin film of Mallory No. 3 flux before welding greatly increased the strength and consistency of the welds. This flux used in the tests had been thinned to a soup-like consistency with water, and was spread on the surface using a cloth moistened with the solution.

With the electrode arrangement given it is believed that fusion of the lead is caused partly by conduction of heat from the tin plate and partly by passage of weld current. For any substantial bonding at all the lead must of necessity be molten and therefore the pressure must be sufficiently low to avoid severe squeezing out of molten lead. Again, the low pressure will minimize indentation made by the electrodes.

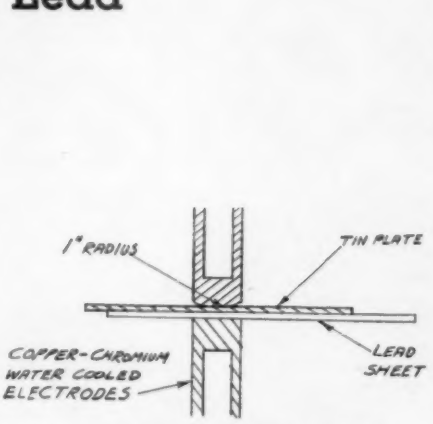


Fig. 1—Electrode arrangement which produced best spot welding results.

Another electrode that might be used and which would tend to further decrease indentation is a copper-chromium electrode with a tip radius of 6 in. and ¼ to ⅜ in. diameter instead of the 1 in. radius tip.

» «

Resistance Welding Process Used in Making Steel Grating

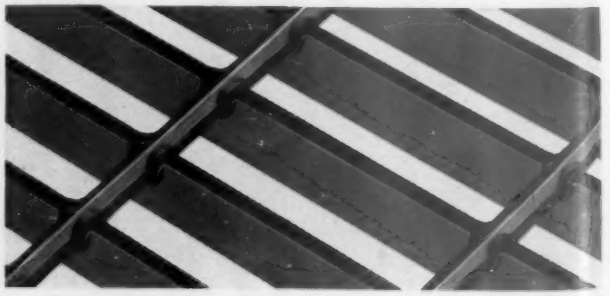
★ In the manufacture of welded steel grating, a resistance welding process is employed to cross weld heavy gauge hexagonal bars to the longitudinal members. These cross bars are forged, two at a time, at a predetermined spacing to form a very rigid grating. In this process a multiplicity of welds are made in one operation. A welding press, similar in appearance to a hydraulic press, is employed for this continuous production process. The grating bars are spaced by means of a jig through which they are passed and an automatic indexing control fixes the hexagonal cross bars on 4 in. centers. A series welding set-up is used, the current passing from one cross bar through the multiple points of contact with the grating bars to the adjacent cross bar and then to the other electrode. The two electrodes required for this job automatically locate the hexagonal bars in correct position. A composite construction is used on these electrodes, using a special copper-tungsten alloy as facing material and a high strength copper-base alloy as backing up material.

The die material for this process is an important factor in its success. A material is required which can withstand exceptionally severe service, because these dies must combine tremendous hardness with compressive strength and high electrical conductivity. The copper-tungsten alloy as die material produces a more uniform product and has a much longer life than any other alloy for this purpose.

Steel gratings made by this unique process are an outstanding example of what can be accomplished through the medium of resistance welding. A one-piece construction is made possible which never works loose and offers great resistance to impact. The tops of all cross bars are flush, providing a smooth, non-slip, trip-proof surface with a high percentage of open area to permit the maximum amount of light and air to pass through.

» «

YOU SHOULD JOIN THE
AMERICAN
WELDING
SOCIETY
•
DON'T DELAY — DO IT NOW!



Welded steel grating provides a smooth, non-slip, trip-proof surface.

News of the Industry

C. G. M. A. Annual Meeting

The 27th annual meeting of the Compressed Gas Manufacturers Association will be held at the Waldorf-Astoria hotel, New York City, January 22-23, 1940. The annual banquet will conclude the sessions. The tentative program for the annual meeting follows:

January 22nd

MORNING SESSION:

Registration. Meeting of Refrigerant Gases Committee.

AFTERNOON SESSION:

This session will be devoted to the 27th annual meeting of members at which reports of officers and committees will be received and an executive board and officers to serve for 1940 will be elected.

January 23rd

MORNING SESSION:

Papers will be presented by **John L. Locke** of Northwestern Blaugas Co., and **A. Cressy Morrison,** both of which will touch upon matters of historical interest.

The luncheon speaker will be **Dr. R. A. McFarland** of Harvard University. Dr. McFarland has made extensive researches into the use of oxygen at high altitudes and the effect of inadequate oxygen supply.

AFTERNOON SESSION:

There will be a group of papers on the transfer of gases. It is anticipated that this discussion will cover the fields of high pressure gases as well as lower pressure refrigerants.

There will be two papers that will concern the testing of cylinders and inspection of steel and steel parts. The first paper will be presented by **L. R. Cartier** of C. & R. Engineering Co., and the second paper by **C. A. McCune** of Magnaflux Co.

RECEPTION AND BANQUET (6:45 p.m.).

» «

1940 Welding Research Program

A $110,000 program of welding research will be carried out in 1940 by the Welding Research Committee of the Engineering Foundation. More than 70 individual projects now in progress in universities and research laboratories throughout the nation will be continued in 1940. Studies in the weldability of steels, weld stresses, structural welding, and progressive failure in steels under repeated stresses will be emphasized. Research sponsored by the Committee aims to assist the steel industry by creating new markets for the use of steel.

"Welding has opened up entirely new fields for the use of steel as compared to other types of construction such as wood, concrete and castings," technical secretary Wm. Spraragen said. "Welding not only offers one of the greatest aids of modern times to the steel industry in keeping existing markets through improvement in quality and lowering of production costs, but it enlarges markets and widely extends the consumption of steel products."

Economies in the production of machinery, structural steel, including material used in prefabricated houses, bridges, and commercial buildings, piping, ships, automobiles, railroad equipment and office furniture have resulted from the use of welding.

Forty-seven reports were issued by the Committee during the past year. Seventeen of these were related to Fundamental Research Investigations, while seven resulted from the activities of the Industrial Research Division.

Other reports covered a wide variety of fields including resistance welding electrodes, stress distribution in welds subject to bending, welding arcs, spot welding low-carbon and stainless steels, crater formations in arc welding, residual stresses in pipe welding, photoelastic studies of stress distribution, miscellaneous investigations in the structural field, welds at low temperatures, control of distortion, welding of silicon bronze, weldability of medium-carbon steels, nickel-clad steels, and others.

Dr. Comfort A. Adams of E. G. Budd Mfg. and former dean of the Harvard School, is chairman of the Committee. The vice chairman is **Harry C. Boardman,** research engineer of the Chicago Bridge & Iron Co. The other members are:

Everett Chapman, president, Lukenweld, Inc., Coatesville, Pa.

J. H. Critchett, vice-president, Union Carbide & Carbon Research Laboratories, New York City.

J. J. Crowe, engineer-in-charge of apparatus research and development department, Air Reduction Sales, Jersey City, N. J.

Arthur S. Douglass, construction engineer, Detroit Edison Co., Detroit, Mich.

C. L. Eksergian, chief engineer, Budd Wheel, Detroit, Mich.

A. J. Ely, mechanical engineer, Standard Oil Development Co., Elizabeth, N. J.

F. H. Frankland, chief engineer, American Institute of Steel Construction, Inc., New York City.

H. M. Hobart, consulting engineer, General Electric Co., Schenectady, N. Y.

D. S. Jacobus, advisory engineer, The Babcock and Wilcox Co.

G. F. Jenks, Colonel Ordnance Department, U.S.A., Army Munitions Building, Washington, D. C.

Arthur E. Pew, vice-president, Sun Oil Co., Philadelphia, Pa.

R. E. Zimmerman, vice-president, United States Steel Corp., of Delaware, Pittsburgh, Pa.

W. Spraragen, executive secretary, technical secretary and editor, American Welding Society, New York City.

The Fourth Biennial Welding Conference will be held at **Texas Technological College,** Lubbock, Texas, on February 2-3, 1940. As in the past, this conference will be conducted by the Mechanical Engineering department in cooperation with manufacturers and users of welding equipment. Lectures will be held in the Engineering building, while demonstrations will be conducted in the Mechanical Engineering shops.

» «

$200,000 Industrial Progress Award Program Announced by Lincoln Foundation

A 2½-year program of scientific study, which will culminate in payment of $200,000 in awards, and which should produce widespread social and industrial benefits, has been announced by **The James F. Lincoln Arc Welding Foundation,** Cleveland, Ohio. A total of 458 awards are established for studies bringing out benefits of a social, economic or commercial nature, such as reduction or elimination of hazards to safety and health, greater availability of comforts and conveniences through reduced prices, greater utility and durability of machines and structures as well as industrial benefits such as cost savings and other advantages in manufacture, fabrication or construction.

Studies to be encouraged with a view to creating such large-scale benefits to society and industry will concern machines, products and structures of all types including: automobiles, trucks, buses, airplanes, locomotives, freight and passenger cars, street cars, ships and boats of all types, buildings, bridges, houses, furniture, heating and air conditioning equipment, electric refrigerators, farming machinery, road-building equipment, as well as industrial machines and products of every conceivable kind.

Awards, ranging from $13,700 to $100, and embracing the 12 classifications and 46 divisions into which the industrial field has been divided for purposes of participation, will consist of:

1st Grand Award—$13,700: The 1st Grand Award, which will be paid for the best progress report submitted, will total $13,700.

3 Main Program Awards: 1st, 2nd and 3rd awards of $10,000, $7,500 and $5,000.

48 Classification Awards: 1st, 2nd, 3rd and 4th awards of $3,000, $2,000, $1,000 and $800, respectively, in each of 12 classifications.

184 Divisional Awards: 1st, 2nd, 3rd and 4th awards of $700, $500, $250 and $150, respectively in each of 46 divisions.

223 Honorable Mention Awards: 223 awards of $100 each for papers which do not share in any other award but which deserve honorable mention.

Innumerable subjects are suited for study. The 12 Classifications and 46 Divisions of participation cover every conceivable machine, building, structure or product made of ferrous or non-ferrous metal.

Classifications and Divisions of Participation

(A) Automotive—A-1 Engines or Engine Accessories; A-2 Bodies or Body

Accessories; A-3 Frames or Frame Accessories; A-4 Trailers.

(B) Aircraft—B-1 Engines or Engine Accessories; B-2 Fuselages or Fuselage Accessories.

(C) Railroad—C-1 Locomotives; C-2 Freight Cars; C-3 Passenger Cars; C-4 Locomotive and Car Parts.

(D) Watercraft—D-1 Commercial; D-2 Pleasure.

(E) Structural — E-1 Buildings and Similar Structures; E-2 Bridges; E-3 Houses; E-4 Miscellaneous.

(F) Furniture and Fixtures — F-1 House; F-2 Office.

(G) Commercial Welding—G-1 Commercial Welders or Job Shops; G-2 Garages or Service Stations.

(H) Containers — H-1 Contents Stationary (Tanks, etc.); H-2 Contents Moving (Pipe Lines, etc.).

(I) Welderies—I-1 Commercial Welderies; I-2 Plant Welderies.

(J) Functional Machinery—J-1 Metal Cutting; J-2 Metal Forming; J-3 Electrical; J-4 Prime Movers; J-5 Conveying; J-6 Pumps and Compressors; J-7 Business; J-8 Functional Machinery (not otherwise classified); J-9 Jigs and Fixtures; J-10 Parts of Functional Machinery.

(K) Industry Machinery—K-1 Processing; K-2 Construction; K-3 Petroleum; K-4 Steel Making; K-5 Farming; K-6 Household; K-7 Food Making; K-8 Textile and Clothing; K-9 Printing; K-10 Industry Machinery (not otherwise classified).

(L) Maintenance—L-1 Machinery and Mechanical Equipment, including truck, bus and taxi fleets; L-2 Structures and other applications for arc welding in maintenance such as pipelines, railroad tracks, bridge strengthening, etc., not covered under L-1.

Opportunities for Participation

Participation in the Progress Program is open to everyone who plays any part in actually bringing about progress in the executive, design, fabrication, manufacture, construction or maintenance phase of industrial product or structure development. Authors of studies may be executives, engineers, designers, architects, draftsmen, plant superintendents, production managers, foremen, proprietors of automotive garages or service stations, owners and operators of fabricating and repair shops, or any other person engaged in the various phases previously mentioned. One author, or a group of authors, may submit a study. Any company or concern may submit more than one study, provided each is on a different subject and is prepared and submitted by a different author or group of authors.

Studies may bring out any and all social, scientific, economic and commercial benefits which attest progress in industrial development. Studies must, however, report progress which can be attributed to application of the electric arc process of welding, within the 2½-year period, January 1, 1940 to June 1, 1942. Such progress may involve one of the following: (a) Redesign and manufacture or construction of an existing machine, structure, building, manufactured or fabricated product of ferrous or non-ferrous metals; (b) New design and manufacture or construction of a machine, building, etc. as in (a); (c) Organization, development and conduct of a welding service; (d) Development, planning and performance of maintenance or repair work with arc welding.

Participants in the Progress Program have 2½-years—from January 1, 1940 to June 1, 1942—to pursue their studies and prepare a report summarizing them. All those planning to qualify should record, for future reference, data in the form of designs, charts, photos, notes and other pertinent information on operations as of December 31, 1939.

All inquiries concerning the $200,000 Industrial Progress Award Program should be addressed to the secretary, The **James F. Lincoln Arc Welding Foundation,** Cleveland, Ohio.

Personals

Dr. William A. Mudge has joined the Technical Division, The International Nickel Co., Inc., 67 Wall St., New York City. For the past 17 years Dr. Mudge has been superintendent of research, superintendent of the refinery and works metallurgist at the company's Huntington, W. Va., rolling mill. Before being transferred to the Huntington plant, Dr. Mudge spent two years at the company's Bayonne, N. J., refinery, where he joined International Nickel in 1920.

» «

D. F. McCandlish, formerly manager of the Oklahoma City district for **Air Reduction Sales Co.,** has been appointed manager of the Detroit district. Mr. McCandlish began his career 15 years ago with the Purox Co., Division of Compressed Gas Corp., later being promoted to branch manager at Kansas City, Mo. Then he became district manager, Tulsa office, of the Stoody Co., manufacturers of alloy steels and equipment. In 1931, Mr. McCandlish joined the Los Angeles office of Air Reduction. For the past four years he has served as district manager of the Oklahoma City office. Mr. McCandlish will make his headquarters at 7991 Hartwick St., Detroit, Mich.

D. F. McCANDLISH

» «

G. J. Dekker, formerly assistant manager of the Detroit district of **Air Reduction Sales Co.,** has been appointed manager of the Oklahoma City district. Mr. Dekker has been associated with Air Reduction in many different capacities for over 20 years. During this time, he has acquired a wealth of experience in solving all kinds of oxy-acetylene welding and cutting problems. Prior to his appointment, Mr. Dekker has served as assistant manager in the Chicago, Cleveland and Detroit offices.

G. J. DEKKER

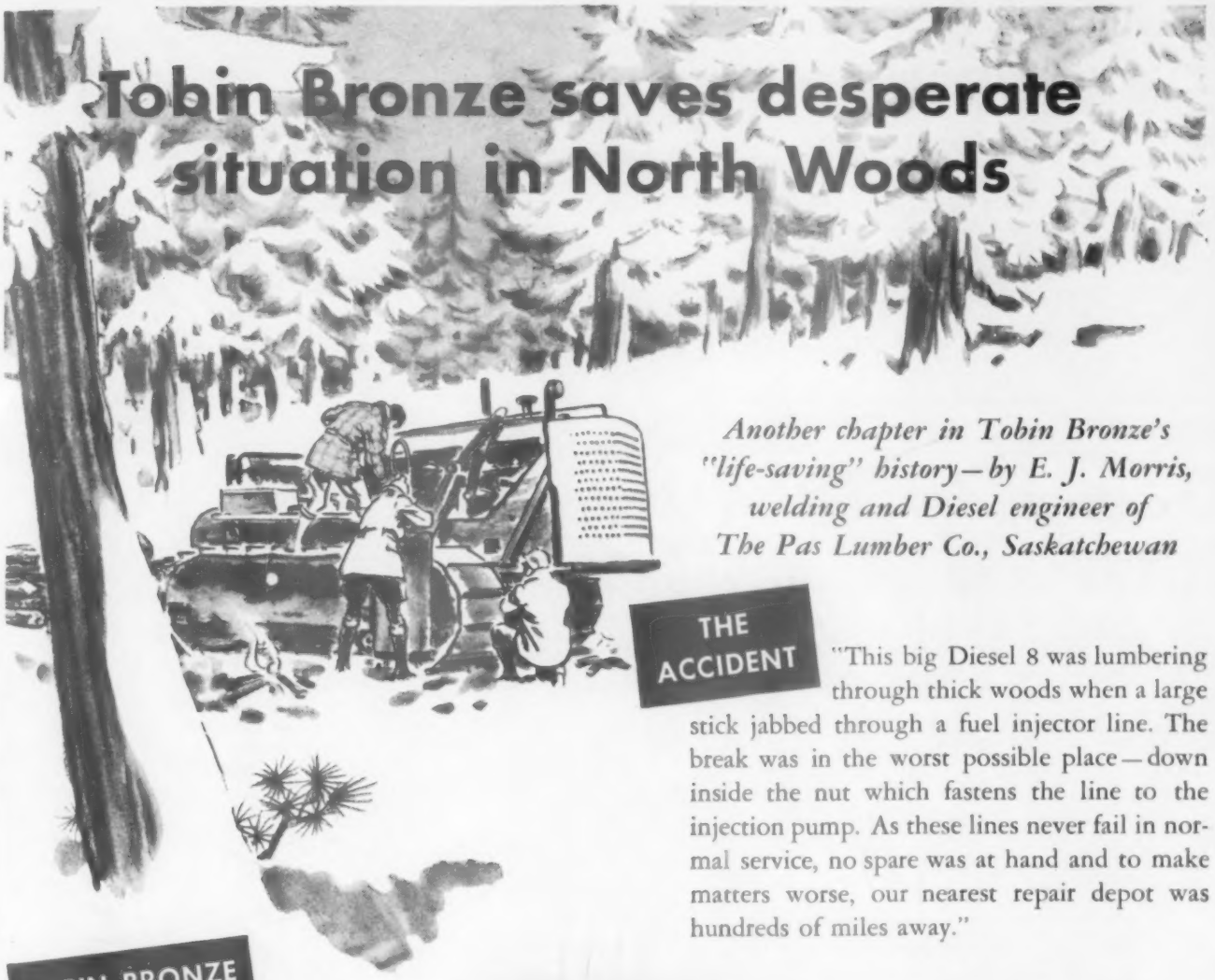
» «

Executive Changes at American Chain & Cable Co., Inc.

C. N. Johns, a vice-president of American Chain & Cable Co., Inc., has been placed in charge of operations, to take over the duties of **C. G. Williams,** a vice-president, whose resignation has been announced. Mr. Johns is a graduate of the University of Missouri. He has had many years of experience in the steel industry, particularly in the manufacture of wire and wire specialties. As vice-president in charge of operations he will supervise the manufacturing activities of the company's 14 plants, in Connecticut, Pennsylvania, New Jersey, Michigan, Indiana, Texas and Canada.

George C. Moon, a vice-president of American Chain & Cable Co., Inc., has been appointed general manager of sales of the company. After operating the George C. Moon Co. for a number of years, he became vice president of the American Cable Co. when it absorbed the George C. Moon Co. He became associated with American Chain & Cable Co., Inc. about 14 years ago when that concern took over the American Cable Co. He will continue active supervision of

Tobin Bronze saves desperate situation in North Woods



Another chapter in Tobin Bronze's "life-saving" history—by E. J. Morris, welding and Diesel engineer of The Pas Lumber Co., Saskatchewan

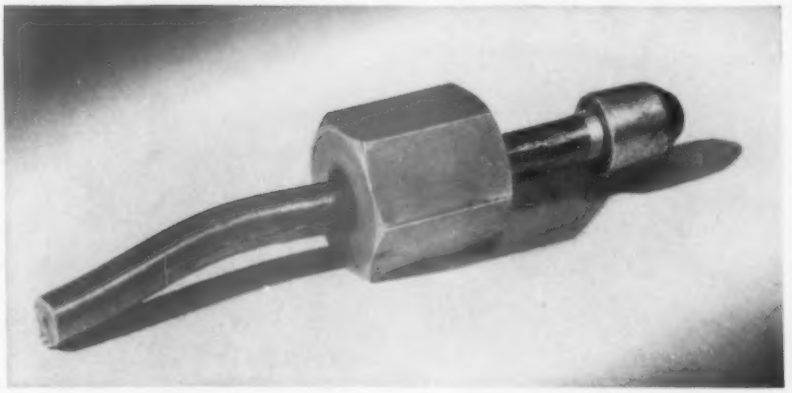
THE ACCIDENT

"This big Diesel 8 was lumbering through thick woods when a large stick jabbed through a fuel injector line. The break was in the worst possible place—down inside the nut which fastens the line to the injection pump. As these lines never fail in normal service, no spare was at hand and to make matters worse, our nearest repair depot was hundreds of miles away."

TOBIN BRONZE TO THE RESCUE

"We decided to try repairing the line with Tobin Bronze welding. In making the repair, the parts were ground cone shaped to allow almost complete penetration of bronze; alignment was secured by running a wire through the parts; and the weld made with Tobin Bronze. In about three hours, the machine was back at work and the welded line, which is subjected to pressures of 1800 to 2500 p.s.i., operated perfectly."

This is another instance proving the value of this Anaconda Welding Rod for difficult jobs on copper and copper alloys, steel and iron. Tobin Bronze carries the trade-mark "Tobin Bronze Reg. U. S. Pat. Off." in each rod. Look for this trade-mark and be sure you are getting the genuine. 39132



The new Anaconda 997 (Low Fuming) Welding Rod—high strength, tough weld metal with low fuming characteristics—is widely used for the general oxy-acetylene repair-welding of cast and malleable iron, steel and copper. Particularly valuable where repairs must be made quickly and easily on machinery parts, engine blocks, etc.

ANACONDA from mine to consumer

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Company

wire rope sales in connection with the wider responsibilities of his new duties. His headquarters will remain at 230 Park Ave., New York Central building, New York City.

William D. Kirkpatrick, who has been general manager of sales of the American Chain Division, has been elected a vice-president of American Chain & Cable Co., Inc. Mr. Kirkpatrick has been with the company for more than 25 years. A graduate of Lafayette College, Class of 1910, he entered the employ of Weed Chain Tire Grip Co. in 1914, as a salesman in the Philadelphia district. He will continue his headquarters at York, Pa., where he has supervision of the sales activities which are directed from that city, covering Weed tire chains, welded and weldless chains, Manley automotive service station equipment, Wright hoists and malleable castings.

» «

Charles G. Williams Joins John A. Roebling's Sons Co.

Charles G. Williams, formerly vice-president in charge of purchasing and manufacturing operations for the 15 plants of the American Chain and Cable Co., Inc., has been appointed general manager of the John A. Roebling's Sons Co., Trenton, N. J.

Mr. Williams was born in Hartford, Conn., on August 25, 1885. He attended the Phillips Andover School in Andover, Mass., and later received his degree in mechanical engineering from the Sheffield Scientific School, Yale University, Class of 1908.

CHARLES G. WILLIAMS

In January, 1913, he was made purchasing agent of the American Chain and Cable Co. plant at Oneida, N. Y. Shortly after the acquisition of the Standard Chain Co. in 1916, he was appointed general purchasing agent of all plants of the company and, in 1928, was made general production manager. In 1930, he was made a director of the company and, in 1936, was appointed vice-president in charge of all manufacturing operations. Mr. Williams will assume his new duties with the John A. Roebling's Sons Co. on March 1, 1940.

» «

T. R. Higgins, chief engineer of New England Structural Co. of Everett, Mass., joined the staff of the **American Institute of Steel Construction** as of January 1, 1940. Mr. Higgins will serve the Institute as engineer in the New York district, and will be available to architects, engineers and others in need of technical advice on steel structures.

Mr. Higgins has been chief engineer for New England Structural Co. for the past 8 years. For 6 years prior to that he was structural engineer for Stone & Webster Engineering Corp. Mr. Higgins graduated from Tufts College in 1921 with a degree of B. S. in civil engineering, following which he was in the Bridge Division of the Massachusetts State Highway Department and later in the Chief Engineer's Office of the Santa Fe Railroad in Texas.

» «

James F. Lincoln on Speaking Tour

James F. Lincoln, president of The Lincoln Electric Co., Cleveland, Ohio, is on an extensive speaking tour. His itinerary includes 12 principal cities in the south, southwestern and western parts of the country. Mr. Lincoln's first engagement is as guest speaker at the annual banquet of the Charlotte Engineers' Club of Charlotte, N. C., on January 11th. He will talk on the subject, "Government Is Made for Man—Not Man for Government."

Mr. Lincoln's subject reveals his staunch belief in the value of personal initiative to the industrial and commercial future of this country. This belief is fur-

For sound OVERHEAD welds use

TITAN MANGANESE BRONZE WELDS

(Trade Mark Registered)

TITAN Manganese Bronze Welding Rods flow freely, readily penetrate seams and crevices and provide extremely dense, non-porous welds. Overhead welds made with TITAN Manganese Bronze will "stay put."

TITAN Manganese Bronze is widely used because of its ability to lay down strong, tough welds in any position. There is no fuming to bother the operator or cause poor welds, because the exclusive TITAN Double Deoxidation process prevents gases from being absorbed from torch, atmosphere or base metal.

Another TITAN Doubly-Deoxidized Alloy preferred by experienced welders is **Penn Bronze**—a general purpose, free-flowing rod, melting at 1620° F.

Samples of these TITAN Doubly-Deoxidized Welding Alloys gladly sent on request. Test them and prove that they produce welds of definitely greater strength and ductility.

TITAN METAL MANUFACTURING CO., BELLEFONTE, PA.

TITAN BRONZE WELDING ALLOYS

JAMES F. LINCOLN

ther evidenced by the spirit which prompted the creation of the Lincoln Foundation, the object and purpose of which is to award individuals for personal effort in studying the possibilities of arc welding in manufacture, fabrication, construction and maintenance of all types of products and structures.

Other cities in which Mr. Lincoln will address executive engineering and industrial groups, include: Birmingham, Ala., New Orleans, La., Houston, Tex., Los Angeles and San Francisco, Calif., Portland, Ore., Seattle, Wash., Pueblo and Denver, Colo., Chicago, Ill., and Salt Lake City, Utah.

Construction

Welded Plant Building—Contracts for design and construction of a welded rigid frame factory of unusual design for the **Portland Manufacturing Co.** at Portland, Mich., has been awarded to **The Austin Co.**, engineers and builders. This newly organized automotive parts manufacturing concern has acquired a 90-acre tract and is proceeding at once to the construction of the initial unit in a plant designed for ultimate expansion to a total of 100,000 sq. ft. The initial project will provide two 40-ft. aisles, each 200 ft. long. Special monitor construction using bent beams will provide bays 40 by 50 ft. entirely without obstruction.

Obituary

Edwin W. Allen, vice-president of General Electric Co. since 1926, died at noon, January 1 in Johns Hopkins hospital, Baltimore, Md., where he had been under treatment following an operation. Mr. Allen, a native of Virginia, was born at Millview, near Buchanan, Va., on November 8, 1879. He was graduated from Virginia Polytechnic Institute in 1900 and entered the employ of the General Electric Co. as a student engineer the following year. He was located in Schenectady until 1911 when he was appointed engineer of the central district, with headquarters in Chicago. He remained in Chicago, except for war service, until 1924 when he was named manager of the engineering department and transferred back to Schenectady. Two years later Mr. Allen was elected a vice-president.

Trade News

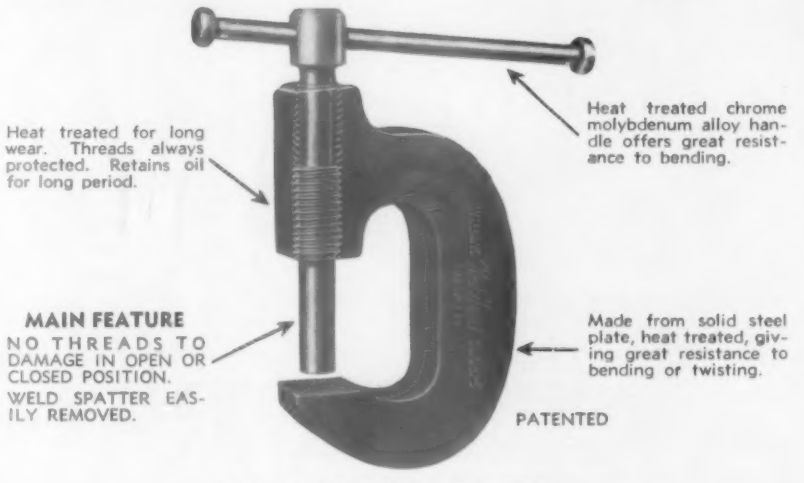
Outlook Bright for 1940—"We in the **General Electric Co.** confidently expect that in both capital goods and consumer goods, business in the electrical industry will be better in 1940 than in 1939," reports **Charles E. Wilson,** president.

"Late in 1939 the output of electricity reached new all-time high levels, clearly indicating the continuing need for more capital goods for generation, transmission and distribution of electricity. These

"Red Head"

WELDING CLAMPS

Withstands All Welding and Handling Abuses


Heat treated for long wear. Threads always protected. Retains oil for long period.
Heat treated chrome molybdenum alloy handle offers great resistance to bending.
MAIN FEATURE
NO THREADS TO DAMAGE IN OPEN OR CLOSED POSITION.
WELD SPATTER EASILY REMOVED.
Made from solid steel plate, heat treated, giving great resistance to bending or twisting.
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14 STOCK SIZES

Special Sizes and Shapes Furnished for Special Applications

INDESTRUCTIBLE CONCEALED THREADS

Red Head Welding Clamps have been especially designed for welding service. Their construction eliminates the trouble caused by weld spatter or accidental damage to threads. A clamp that will stand up under the most rigorous service over long periods of time.

A trial will convince you. Send for sizes and prices today.

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CHICAGO BOILER COMPANY

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high levels also reflect increased industrial activity and the more urgent related need for capital goods for plant modernization and for low cost production by means of efficient electrically-energized equipment.

"Larger farm incomes and expanding payrolls in manufacturing and service industries should further stimulate the growing demand for consumer goods as represented by home appliances for better living. A greater appreciation of the relationship of good light to good sight, together with application of new forms of lighting, broaden the outlook for this field. Through research and invention, new services—and new opportunities for more widespread employment—are constantly being made available.

"In reaching these conclusions, due consideration has been given to the uncertainties arising from conditions abroad, as well as to our unsolved domestic problems, but in support of our confidence, we are increasing our expenditures and commitments not only in anticipation of, but as an aid to, better business in 1940."

» «

George H. Bucher, president of **Westinghouse Electric & Mfg. Co.** in a year-end statement said, in part: "Though the world's attention throughout the past year has been focused on war, the most important contributions of American engineers and scientists have furthered the arts of peace. The year has seen important strides in the electrical field, and in the electrification of industry. Many industrial plants, including several large steel mills, are producing better, cheaper products because of the 1939 electrical equipment that operates and controls them. During the year several alloys of considerable importance have been produced. One alloy, "K-42-B," containing nickel, cobalt, chromium, titanium, manganese, silicon, carbon and iron, may prove spectacularly useful at high temperatures. It is stronger at 1100 deg. F. than carbon steel at room temperatures," he stated. "The business of the Westinghouse Co. has been very good in 1939, and we expect that the present high level will be maintained into 1940."

» «

Metal Bond Manufacturing Co., formerly at 4211 N. Broadway, St. Louis, Mo., has moved to new and larger quarters at 3201 Kossuth Ave. This change of address became effective January 15, 1940.

» «

Westinghouse Names Two New Directors—Two new directors of Westinghouse Electric & Mfg. Co. were elected at a recent board meeting. They are **George A. Blackmore,** president of Westinghouse Air Brake Co. of Pittsburgh and of the Union Switch and Signal Co. of Swissvale, Pa., and **Arthur W. Page,** a vice-president and director of the American Telephone and Telegraph Co. of New York, and a director of the Continental Oil Co.

» «

Dymonhard Corporation of America, manufacturers of Dymonhard facings, have moved their offices to enlarged quarters at 250 West 57th St., New York City, as a step in a program of expansion necessitated by increased business.

» «

Steiner-Ives Co. Moves to New Location—Steiner-Ives Co. has moved from Bloomfield, N. J., to a new location at 14-16 Avenue L, Newark, N. J., increasing factory space about three times and greatly improving its manufacturing facilities. An increasing demand for Steiner-built industrial ovens is given as the reason necessitating this move. Excellent transportation facilities are provided at the new location. Steiner-Ives Co. is the newly incorporated name of the former organization, Steiner Oven Co. The latter is now organized as the Steiner Oven Division of the new company and will continue to specialize in the design and construction of industrial ovens for medium-temperature purposes.

» «

American Solder and Flux Co. has moved to their new location at 2152-54 E. North St., Philadelphia, Pa.

A. W. S. Activities

Milwaukee A. W. S.—"Design As It Affects Welding Costs" was the subject presented by **A. E. Gibson,** president of Wellman Engineering Co., Cleveland, Ohio, at the regular meeting of the Section on December 15, 1939, held at the City Club, 756 N. Milwaukee St.

» «

Detroit Section A. W. S.—At the regular meeting held January 5, 1940, in the English Room of the Detroit-Leland Hotel, **George C. Mikhalapov,** welding engineer of Baldwin-Southwark Corp., Philadelphia, Pa., spoke on "Importance of Fundamental Research in Resistance Welding." Mr. Mikhalapov is chairman of the Resistance Welding Committee, Industrial Research Division, Welding Research Committee of the Engineering Foundation.

» «

Cleveland Section A. W. S.—At the regular meeting held on January 10th, at Fenn College, **E. W. Forkner,** presented a paper entitled "Manufacture of Process Machinery by Arc Welding and Gas Cutting."

» «

Philadelphia Section A. W. S.—At the January 15th meeting held at the Engineers' Club, 1317 Spruce St., Philadelphia, Pa., the subject of "Modern Welding Developments" was presented by a representative of A. O. Smith Corp., Milwaukee, Wis.

» «

St. Louis Section A. W. S.—Harry C. Boardman, research engineer, Chicago Bridge & Iron Co., discussed the subject of "A. W. S. Standard Qualification Procedure" at the regular meeting held January 12th.

» «

New York Section A. W. S.—Harry E. Rockefeller, manager, Process Development Dept., of Linde Air Products Co., spoke on the subject "Plate Edge Preparation for Welding" at the January 9th meeting of the Section, held in Room 502, Engineering Societies Bldg., 33 W. 39th St., New York City. Mr. Rockefeller's paper described a number of recent developments in plate edge preparation, including U-grooving and simultaneous

(Continued on page 52)

REGISTERED U.S. MANGANAL PATENT OFFICE

***NEW!* TITE-KOTE WELDING ELECTRODE**

for A. C. and D. C. Welding

This newly-introduced electrode for A. C. and D. C. welding is identical with the regular MANGANAL electrode, except that it possesses a ***SPECIAL SELF-PEELING COATING that in no way retards the quick cooling of the weld deposit.***

Welds made with this new electrode possess the same ductility and toughness possessed by deposits made with MANGANAL bare electrodes.

Available in 1/4, 3/16, 5/32 and 1/8 in. sizes (14 in. length). Packed in 50-lb. containers.

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Manufacturers of MANGANAL Manganese Nickel Steel WEDGE and APPLICATOR BARS, Hot Rolled PLATES, etc. Descriptive circulars sent on request.

Resistance Welding Progress

(Continued from page 40)

equipment, material heavier than two pieces of ⅜ in. could be satisfactorily welded.

Electrodes

The recent advance in alloys available for spot-welding tips, seam-welding wheels and butt and flash butt welding jaws or dies has been of great value to the users of resistance welding, and range from pure tungsten or molybdenum through mixtures of copper with tungsten, molybdenum or both, and precipitation-hardening or work-hardening alloys of copper with cadmium, cobalt, chromium, beryllium, silver and many others. The use of these various alloys with proper water cooling has lowered maintenance costs and increased the life of these parts tremendously. Use of the proper alloy electrode, rather than copper is advisable for all resistance welding applications.

Vang Method

Where condensers are charged with a low value direct current, then discharged directly across the weld forming a short high-voltage arc, the energy is capable of making some types of weld of very high quality with practically no upset and very little transfer of heat out of the weld area. This seems to have possibilities for making some welds which are difficult or impossible to make by other methods.

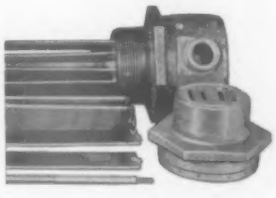
Weld Recorder

There is now available a weld recording instrument which has a deflection which is proportional to I^2T where I is the current and T is the time of current application. Since the heat generated in a resistance weld is proportional to I^2T, the deflection of the instrument is approximately proportional to the total amount of heat developed at the weld.

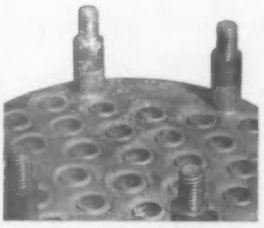
Failure of the control to time properly, variations in voltage, loose connections, variation in resistance of the work, electrode diameter, pressure or any other part of the welding operation will be recorded in so much as these variables may cause a change in the time of current application or the value of current. This recorder should be very useful, protecting a manufacturer against faulty welding, particularly resulting from variations in voltage, current, failure of the control, loose connections.

Just try EASY-FLO ... on one job—

STAINLESS STEEL TO STAINLESS STEEL



STEEL TO CAST BRONZE



COPPER TO STEEL

You're in for a surprise the first time you braze with EASY-FLO. You're going to be surprised by EASY-FLO'S ***extreme fluidity*** at the low working temperature of 1175 Deg. F. You're going to be surprised, too, when you see how rapidly EASY-FLO penetrates between closely fitted parts . . . what a small amount it takes to do a job . . . and what clean, neat joints you get . . . joints that need little or no finishing.

Then, when you test the joints, you'll understand fully why we emphasize high strength, leak-tightness, and the remarkable ability of EASY-FLO brazed joints to withstand shock, vibration and temperature changes.

Just pick out one of your metal joining jobs . . . ferrous, non-ferrous or dissimilar metals . . . and try EASY-FLO* on it. You will no doubt find, like so many others have, a dozen places where EASY-FLO will speed up your metal joining and cut costs.

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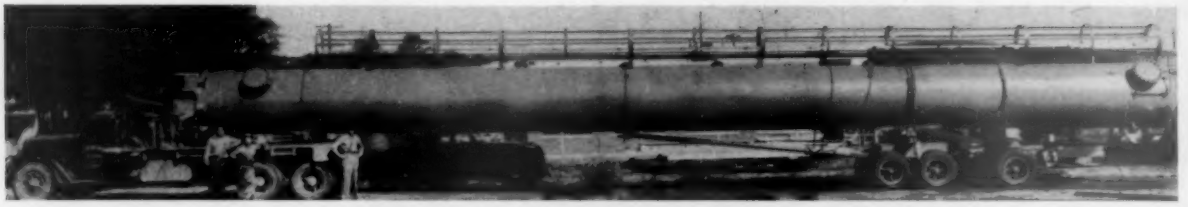

An all-welded absorber, fabricated by the J. B. Beaird Corp. at Shreveport, La. This refining vessel was designed by The Hudson Engineering Co. of Houston, Texas, for the Hercules Gas Co. at Kilgore, Texas. The picture was made as this 54,000 lb. absorber left the Beaird plant at Shreveport, for its 75-mile trailer trip to the refinery at Kilgore, Texas.

single-bevel and nose, and double-bevel and nose preparations.

At the same meeting, **Harry W. Pierce,** supervisor of welding, New York Shipbuilding Corp., Camden, N. J., spoke on "Gas Machine Cutting and Shipbuilding."

Recent Patents

Spot Welding Tool

2,179,497. **Sergo B. Davitow,** St. Albans, N. Y. Filed Aug. 8, 1938. Issued Nov. 14, 1939. The subject of this patent is a portable spot welding appliance especially intended for welding flat pieces or sheets of material together. The tool serves to hold the pieces together under sufficient physical pressure to insure a good weld. The welder may be applied manually in operative position, whereupon a compound-lever arrangement magnifies the pressure of the operator's hand so as to insure a perfect spot weld between the electrode points. The welder is shaped somewhat like a pair of tongs. Suitably fulcrumed elements apply pressure of electrodes to the work pieces.

» «

Resistance Welding

2,179,545. **Alfred J. Edge,** Savannah, Ga., and **Walter S. Edge,** Pittsburgh, Pa. Filed Jan. 28, 1937. Issued Nov. 14, 1939. A method of forming resistance welds between two metal members which consists of bringing the two members together in crossed relation, passing an electric current through their point of contact, applying pressure to force them together and simultaneously applying pressure to one of the members in directions axially thereof and toward the weld, to cause an upsetting action at the weld. This type of welding is particularly suited for such metals as copper, steel, aluminum, and bronze. The invention takes advantage of the heat developed at the weld, which softens the adjacent portions of the metal, to forge or press the joint into a shape of increased mechanical strength.

» «

Pivotal Electrode

2,179,693. **George Goldstein,** Oshawa, Ontario, Canada, assigned to **General Motors Corp.,** Detroit, Mich. Filed Oct. 30, 1937. Issued Nov. 14, 1939. In certain welding operations, such as spot welding, it has ben proposed to use an electrode that is pivotally mounted so that the pressure on the work may be equallized. Where an electrode is made of two parts that are pivotally connected, and it is desired that the welding current pass through the connection, considerable arcing may take place. The arcing has a deleterious effect on the life of the electrode. The inventor has found that if a coating of mercury is applied to the adjacent or contacting faces of the movable parts, as for example, the faces of a ball and socket connection, the life of such a welding electrode is greatly increased. The mercury establishes a good electrical connection between the parts and also acts as a lubricant.

» «

Welded Pressure Vessel

2,179,774. **Frederick K. Zerbe,** Waukesha, Wis., assigned to **A. O. Smith Corp.,** Milwaukee, Wis. Filed Dec. 7, 1935. Issued Nov. 14, 1939. In fabricating pressure vessels of cylindrical shape having a cone-shaped end or head, it has been the practice frequently to employ metal of substantially greater thickness in the cone head than in the vessel shell wall and to place in juxtaposed relation the end of the straight-sided shell and cone. The parts have then been welded together, the weld being located at the position of abrupt change in direction between cone and shell. By providing a gradual approach or curvature of the cone toward the shell, and by moving the position of the welded joint a substantial distance from the position of maximum curvature of approach, the patent discloses that the zone of approximate maximum stress between the shell and conical head is removed from the weld joint to the metal of the cone. When pressure is applied in the vessel it is desirable to avoid concentration of stress at the weld, where the effect of stresses due to shrinkage and other causes resulting from non-similarity between weld metal and plates exists. The patented structure is designed to transfer the stress away from the weld.

» «

Welder Control

2,179,957. **Frank H. Roby,** Milwaukee, Wis., assigned to **Square D Co.,** Detroit, Mich. Filed July 1, 1937. Issued Nov. 14, 1939. A welder control system for electrically welding work by passing current through the work between electrodes, and which utilizes a synchronizing relay to initiate the welding cycle. The control uses a motor-driven contact making and breaking unit for starting and stopping the current.

Relieving Weld Stresses

2,180,513. **Alfred P. Fugill,** Ferndale, and **Donald H. Corey,** Grosse Pointe, Mich., assigned to **Kuhlman Electric Co.,** Bay City, Mich. Filed July 27, 1936. Issued Nov. 21, 1939. In the past, difficulties have been experienced in relieving stresses set up in welded joints of pipes. An electrical appliance devised by the patentee uniformly heats a welded joint to a predetermined temperature, maintains the temperature within close limits, and then cools the joint. The unit is essentially a split winding in the form of a multi-turn coil having each turn formed of a pair of accurate sections. The split winding may be clamped over the welded joint. A transformer provided with a number of winding taps supplies increased or decreased amounts of current to the split winding or heating coil. The heat control is accomplished by means of a potentiometer actuated by a thermocouple attached to the weld. The potentiometer is connected with suitable switches for energizing and deenergizing the transformer in response to changes in the weld joint temperature.

» «

Welding Electrode

2,180,813. **John T. Marvin,** Dayton, Ohio, assigned to **General Motors Corp.,** Detroit, Mich. Filed Feb. 3, 1938. Issued Nov. 21, 1939. A method of making a flux-carrying welding electrode, including the steps of; molding finely divided metal powder into the desired shape, sintering the molded powder to cause it to fuse together and form a strong highly porous electrode of homogeneous character, and then impregnating the porous metal electrode with suitable non-metallic fluxing ingredients which solidify and are thereby held within the pores of the electrode.

» «

Method of Welding

2,181,445. **James L. Adams, Jr.,** Youngstown, Ohio, assigned to **The Youngstown Sheet & Tube Co.,** of Ohio. Filed Aug. 7, 1928. Issued Nov. 28, 1939. According to this patent heavy sections of metal may be welded continuously at high speed. The method comprises inducing a heating current flow in the material to be welded transversely of and across the edges of the material, effecting bodily forward movement of the material during the pre-welding heating up operation, controlling the position of the edge portions of the material, and progressively moving the edge portions during the pre-welding heating up operation in a direc-

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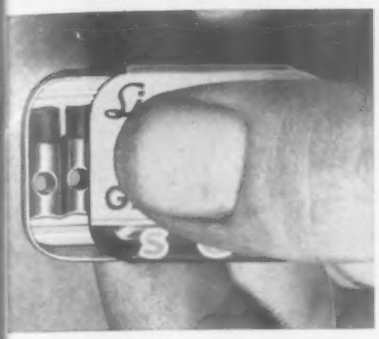

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tion substantially parallel to the current flow to vary the amount of spacing between the edge portions, and then applying sufficient pressure to the material to weld the same. An apparatus for carrying out the method is also shown in the patent.

» «

Flash Welding of Strip

2,181,502. **Florence C. Biggert, Jr.,** Crafton, Pa., assigned to **United Engineering & Foundry Co.,** Pittsburgh, Pa. Filed June 24, 1937. Issued Nov. 28, 1939. The object of this patent is to flash weld metal strip end to end and thereafter trim the flash from the line of weld. The method involves the steps of clamping the strip ends in aligned relation, shearing the ends to prepare them for welding, connecting the ends to a source of low potential high amperage current, and effecting relative movement between the ends to flash weld them together. The flash is thereafter removed from the line of weld by a rotary movement of helical knives in the form of rotary disc shears.

» «

Corner and Fillet Welds

2,182,575. **Albert W. Baird,** Elizabeth, N. J., and **Frederick G. Outcalt,** New Rochelle, N. Y., assigned to **The Linde Air Products Co.,** of Ohio. Filed Aug. 7, 1937. Issued Dec. 5, 1939. In fabricating various types of electrically welded joints, such as corner welds, fillet welds, and the various forms of welded joints for pipe turns, the welding rod must be fed to the work at an angle to the vertical plane through the line to be welded. The invention provides a welding head adapted to automatically feed a continuous welding rod to the work. A support, and guiding and adjusting elements maintain the welding rod in a proper position relative to the work. The electrode feeding mechanism is substantially universally adjustable with respect to the support for the welding head for feeding the welding rod to the work at any desired angle. The device also automatically insures provision of proper amount of welding material adjacent to the welding rod.

Seam Welding

2,182,796. **Geo. M. Deming,** East Orange, N. J., assigned to **Air Reduction Co., Inc.,** New York. Filed Jan. 20, 1936. Issued Dec. 12, 1939. In welding heavy sections it is customary to prepare the edges by so shaping them that they will form a trough. The trough is then filled with metal from a welding rod or electrode. Simultaneously with the melting in of the filler metal it is customary to melt down the sides of the trough to insure homogeneous union of parent and added metal. The necessity of melting a large quantity of metal requires expenditure of a large amount of heat energy. Moreover, the speed of welding is limited. According to this invention, a filler rod is used, but it is not melted away in the usual manner to fill the trough. Instead, the filler is progressively heated to bring its sides to a condition of surface fusion, while the sides of the trough are progressively heated, whereupon the rod is progressively pressed into the groove. Since the successive portions of the surfaces of the filler rod and trough are heated and fused before each portion of the rod is introduced into the trough, there is an opportunity to destroy surface oxide films. The advantages of the invention are most completely realized when the lateral surfaces of the filler rod are fused to such an extent as to supply an excess of molten metal the better to obliterate irregularities of interfacial conditions, and also to insure smooth bond-

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ing contours for the weld. In addition, fluid metal dislodged by the welding flame or squeezed from the filler makes certain the filling of the bottom of the weld. The cross section of the filler rod should correspond substantially to the shape of the trough between the metal parts. The best form is a V trough and a V-shaped filler, since that form requires relatively little pressure to insure a complete and uniform bonding.

» «

Welded Rail Joint

2,183,047. **Charles Schenck,** Coopersburg, Pa., assigned to **Bethlehem Steel Co.,** Pa. Filed Dec. 30, 1937, Issued Dec. 12, 1939. A method of making a continuous rail, which consists in cutting the ends of two rail sections each having a head and a base flange connected by a web, the cutting of the head ends being at right angles and of the web and base flanges being at an oblique angle to the longitudinal axis of the rail sections. The cut ends are then aligned with their complementary ends adjacent to each other, and then flash welded.

Trade Literature

Hercules Motors Corp. Issues New Booklet—A concise yet comprehensive explanation of modern high-speed, heavy-duty diesel engines is covered in a new booklet just issued by Hercules Motors Corp. of Canton, Ohio. Handled in question and answer form, some very interesting comparisons are presented between diesel engines and gasoline engines; also between the two-cycle and four-cycle types of diesel engines. The complete line of Hercules two-cylinder, four-cylinder and six-cylinder engines is shown, including the Hercules complete "Power Package" replacement diesel for Ford trucks for the years 1935 to 1940, inclusive.

» «

General Electric Offers New Motion Picture Catalog

A new catalog of motion pictures is now offered by General Electric Co. The pictures, both sound and silent, are designed for the use of organized groups such as educational institutions, technical societies, churches, and social, civic, and business clubs. With the exception of a small shipping charge, there is no cost to the borrower of these films.

The new catalog lists the films under the classifications of science, generation and distribution of electricity, transportation, electric equipment, industry, light and lighting, welding, and household appliances. Listed in the catalog are 12 distribution points throughout the country. Five silent films (16 mm.) are available on the subject of welding: The Electric Needle (No. 52); Ties of Steel (No. 54); Automatic Arc Welding (X-311); Welding Battered Rail Ends (X-388); Arc Welding in Building Erection (X-389).

» «

Booklet on Stainless-Clad Steel—A new 24-page booklet which contains useful information on Jessop Silver-Ply stainless-clad steel for fabricators of stainless equipment, has just been issued by the

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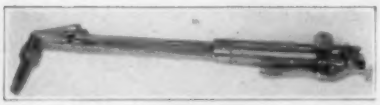

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Silver-Ply is a composite sheet or plate consisting of a layer, or ply, of stainless steel which has been firmly welded to a mild steel backing during the rolling process. The new booklet describes its advantages over solid stainless, how it is manufactured into sheets and plates, and how it is fabricated into finished equipment. Also included is a full page table showing the physical properties of Silver-Ply after welding.

Fabricating methods described include, cold fabricating, deep drawing, flame-cutting, riveting, welding, soldering, grinding and polishing. The description of welding procedure is amply illustrated with line drawings. A free copy of the new booklet will be sent to anyone requesting it on company letterhead.

» «

M.S.A. Welding Helmets—A new 4-page bulletin detailing M.S.A. welding helmets and accessory protective equipment, containing 30 illustrations of representative M.S.A. products, is available upon request to **Mine Safety Appliances Co.**, Braddock, Thomas & Meade streets, Pittsburgh, Pa.

M.S.A. welding helmets in new one-piece or fabricated models are shown, together with hand shields, wire screen helmets, chrome leather helmets, welder's chrome leather gauntlets, leggings, sleeves and aprons. Various parts and features of the M.S.A. helmets are described, and related items for the welder's safety are included, such as ear protectors, air line respirators, and the M.S.A. Explosimeter and Air-Mover.

» «

"Continuous Welded Rail," an illustrated folder just issued by **Air Reduction Sales Co.**, discusses Airco methods of preparing jointless track for mine car haulage. The folder describes in detail three leading methods used in butt welding of rail: Bronze welding by the oxy-acetylene process, and steel welding by the metallic arc process. Complete descriptions cover preparation of joint and equipment used, as well as common applications of the particular process. Results of exhaustive load tests are given, followed by a brief discussion of Airco equipment used in continuous rail welding. Copies of this folder may be obtained by writing to **Air Reduction Sales Co.**, 60 East 42nd St., New York City.

» «

1940 Black & Decker Catalog—The Black & Decker Mfg. Co., Towson, Md., has just issued its 1940 catalog which covers the entire line of portable electric tools. Attention is called to two improved drills —the ¼-in. Junior and the ½-in. Junior.

» «

The Airco No. 10 Planograph, a new 4-page bulletin published by Air Reduction Sales Co., describes this gas-operated cutting machine designed for cutting straight lines, rectangles, circles and irregular shapes from ferrous metal of any thickness within the limits of the cutting torch. The bulletin contains a complete pictorial representation of the Planograph, as well as operating details and specifications. Features of the device are listed, such as its wide cutting range, single or two-torch operation, centralized location of electrical controls, interchangeable devices for manual tracing or magnetic and templet tracing, and central gas control unit. Copies of this bulletin may be obtained by writing to Air Reduction Sales Co., 60 East 42nd St., New York City.

» «

General Electric Arc-Welding Electrodes—A new bulletin on the selection of General Electric arc-welding electrodes is now available (GEA-1546F). Prepared as a guide for the proper selection of electrodes, the publication also gives important suggestions on welding technique with different types of electrodes and presents some of the factors influencing their choice. Complete descriptions are given of the 20 types of G.E. electrodes, their applications, sizes, recommended currents, arc-voltages, and identification. Profusely illustrated with application photographs, this 40-page publication contains characteristics of deposited weld metal, charts of joint form and positions, and a handy estimator for electrode quantities. Copies are available from the nearest General Electric distributor.

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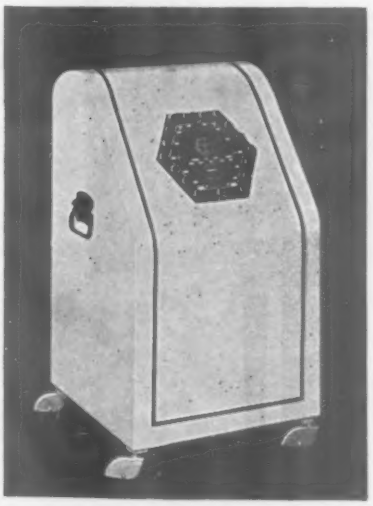

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Foreign News

British Welding and the European War

During the year of rearmament preceding the present European War, there has already been a general increase of welding on a considerable scale. On the home front, particularly, there was a rising demand for electrodes and equipment for the manufacture of shelter for factory staff and key-men, as it was appreciated that protection against blast from bomb explosions was better attainable by solid joints than by riddling material with rivet-holes. The advantage of welding was also realized in producing gas-proof joints.

On the outbreak of the war, the welding industry mobilized all its forces for assuring victory. On the man-power side, equipment manufacturers have maintained their welding schools, while the Institute of Welding has been working out a scheme for training operators in all branches of the craft. The Institute has also put its services at the disposal of the three Military Services and is authorized by the Government to act as liaison organ between welding contractors and localities where metal structures may be damaged by aerial bombardment. Finally, the War Office has sanctioned recruiting for a Welding Company of "Royal Engineers," whose main duties will apparently be to build bridges and erect buildings. The repair of heavy machinery is seemingly of lesser importance. This is an innovation in the British Army, but follows the example of the American troops in the last war, when a welding company of 6 officers and 300 men was sent to France.

In the present conflict, the experience gained from this first unit will probably lead to its duplication several times over, particularly when land operations start in earnest.

Returning to the home front, the manufacturers have found themselves overwhelmed with orders for welding equipment and materials. In spite of this, commercial research work is still going on. There seems to be a trend toward wider use of a-c. current for electric welding.

The phantom presence of the two German pocket battleships in the Atlantic, as commerce destroyers, lends particular interest to their all-welded structure. It is a known fact that the German Admiralty had employed welding very extensively on cruisers and smaller warships ever since the French occupation of the Ruhr. German practice had reached the stage where the entire hull was fused into a seamless unit. This paved the way for the welded construction of the "Deutschland" and her sister-ships.

Not that Britain has altogether neglected the use of welding on her fighting navy; a beginning was made on the superstructure of the "County" class of light cruiser, as well as the "Leander" type of 7,000 tons, with 6-in. guns. The first hull to be welded was the "Arethusa" of the same class. Here, "step-back" or intermittent welding was applied on the plates, in order to avoid over-heating them, while in confined spaces, such as the fore and aft ends of a vessel. Lap-welds were broken into butt welds with a 60 deg. vee.

The universal introduction of welding was decided upon at an advanced stage, so that numerous modifications were required for this purpose. Another vessel of which welding may be proud is the "Ark Royal," still a part of the squadron of "sunk" ships with which Churchill has challenged the Nazi navy. Though Admiralty secrecy has not released full details, she is said to be 75% welded, including all her deck-surface.

Classified Section

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